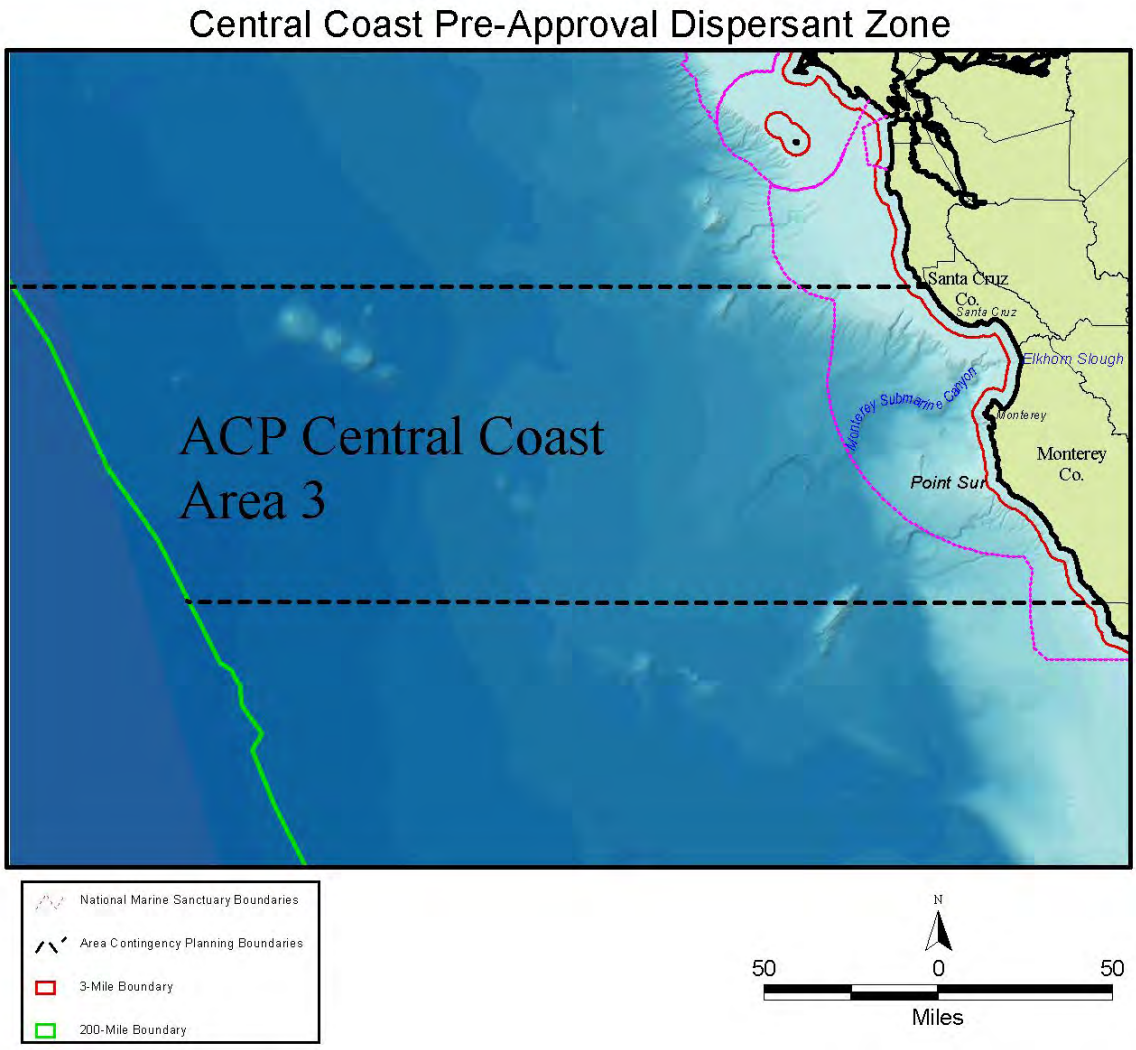
B.3 Central Coast



The Central Coast dispersant use pre-approval area includes all waters seaward of the 3-mile state waters line (shown in red), shoreward of the 200-mile line (shown in green) and outside the Monterey Bay National Marine Sanctuary (shown in magenta). Areas inside state waters or National Marine Sanctuaries are "RRT Approval Required"; RRT approval will be case-specific.

Oil spills within the offshore region of the Central Coast initially threaten all sea birds and marine mammals that frequent the area. If the spilled oil is driven on shore by the sea conditions and prevailing winds, additional resources (*e.g.*, shore birds, intertidal organisms, seal and sea lion pups) are at risk for oiling.

Seabirds off California are generally most abundant in nearshore waters over the continental shelf; abundance drops off dramatically over the continental slope and deep offshore waters. High concentrations of seabirds occur in nearshore waters off Santa Cruz and Monterey counties, although seabird abundance drops south of Pt. Sur due to low water column productivity. Sea birds seasonally tend to concentrate near upwelling zones, in and "down stream" of offshore current jets associated with headlands, along

temperature and salinity gradients, and along the shelf break. Both seabirds and marine mammals concentrate in these regions due to the high abundance of food.

Sea bird densities are typically highest during the late summer through fall and winter periods (July through January) and lowest in April to June when birds are concentrated on their colonies. In general, sea bird densities decrease when moving from the inshore to the offshore environment, dropping off considerably seaward of the continental shelf break.

Over 100 species of sea birds have been reported from the region; about 70 of these species occur regularly. In the offshore (water depth > 200m) waters, common sea bird species occurring seasonally include sooty shearwaters, phalaropes, Leach's storm petrel, northern fulmars, black-legged kittiwake, herring, Bonaparte's, western and California gulls, Cassin's and rhinoceros auklets, and common murres. In Monterey Bay proper, a significant segment of the world's ashy storm-petrel population is present during the autumn. Near shore (water depth <200m), common species include sooty shearwaters, phalaropes, common murres, loons, western grebes, and western, California and Bonaparte's gulls. In addition, endangered species including brown pelicans, marbled murrelets (northern area of region), western snowy plovers, and least terns occur seasonally in the nearshore area and would be at risk from oil entering this area.

Of all the sea birds occurring in the region, the common murre appears to be one of the species most frequently involved in oil spills. Data collected by the Office of Oil Spill Prevention and Response indicate that common murres are the most frequently oiled bird collected during recent central and northern California spill responses (Monterey Bay Mystery Oil Spill, 1997; Pt. Reyes tar ball incidents, 1997-98; T/V *Command* spill, 1999; San Mateo Mystery Spill (*Jacob Luckenbach*), 2001-03).

Shorebirds are another important component of the avifauna of the Central Coast area. More than 40 shorebird species have been recorded in central California; however, many of these are extremely rare, and only about 24 species occur regularly in the area. Although the majority of shorebirds occupy coastal wetlands, including estuaries, lagoons, and salt and freshwater marshes, they also occupy other coastal habitats, including sandy beaches and rocky shores. Common shorebird species in the area include black-bellied plover, willet, whimbrel, marbled godwit, black turnstone, sanderling, western sandpiper, least sandpiper, dunlin and dowitchers. Breeding shorebirds are limited to black oystercatcher, black-necked stilt, American avocet, killdeer, and the threatened western snowy plover, which nests and winters on sandy beaches.

Because of their migratory nature and the fact that few breed in the area, shorebirds are most abundant from fall through spring; comparatively few shorebirds remain during the summer months

A number of marine mammal species are potentially at risk from spilled oil in this region of the coast. At least 34 species of marine mammals inhabit or visit California waters. These include six species of pinnipeds (seals and sea lions), 27 species of cetaceans (whales, porpoises and dolphins) and the sea otter. Cetaceans, including a number of endangered species (blue, humpback, fin, sei, right and sperm whales), use area waters as year-round habitat and calving grounds, important seasonal foraging grounds or annual migration pathways. Neither of the two threatened or endangered pinniped species occasionally seen in the area (Guadalupe fur seal, Stellar sea lion) breed here, but a large breeding population of northern elephant seals occurs at Año Nuevo, directly to the north and adjacent to the Central Coast planning area. California sea lions, harbor seals and sea otters also occur here. Harbor seals breed on offshore rocks and isolated beaches of the central coast. Aside from the breeding locations (Año Nuevo, the central coast) thousands

of pinnipeds (elephant seals, California sea lions, harbor seals, Guadalupe fur seals, northern fur seals, Stellar sea lions) feed in and move through the area as either resident or migrating populations. The sea otter, a year-round resident of mainland central coast nearshore waters (generally within 6 miles of shore), is an endemic population of limited range and numbers currently experiencing population stress.

Marine mammals vary in their susceptibility to the effects of oiling. Since oil can destroy the insulating qualities of hair or fur, resulting in hypothermia, marine mammals that depend on hair or fur for insulation against the cold are among the most sensitive marine mammals to the effects of oil contamination. Most vulnerable to the direct effects of oiling among the pinnipeds are fur seals and newborn pups, which lack a thick insulating layer of fat. Cetaceans, which rely on layers of body fat and vascular control rather than pelage to retain body heat, are considered less vulnerable to the effects of oiling than pinnipeds.

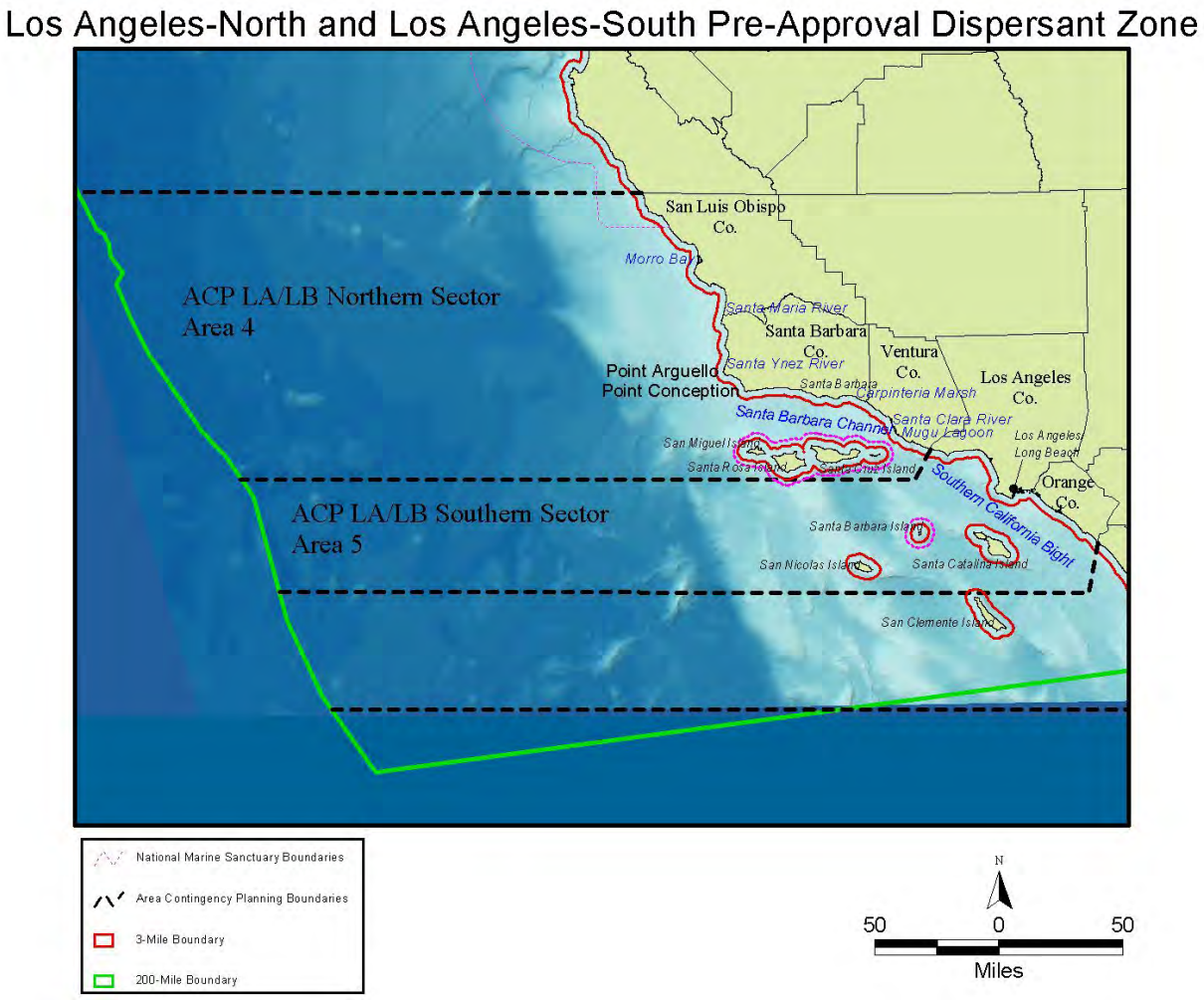
Sea otters would be at high risk from an oil spill if oil were to reach nearshore waters of the region where most of the population is concentrated. Depending on the time of year, heavy oiling of intertidal and upland areas of the mainland coast could also threaten harbor seal and northern elephant seal pups.

At least 554 species of California marine fishes inhabit or visit California waters. The high species richness is probably due to the complex topography, convergence of several water masses and changeable environmental conditions. The Monterey Submarine Canyon is an extremely important topographical feature in the central coast region, to which the area's large faunal species diversity and density is attributed. The fish represent a mix of permanent residents and periodic visitors. The important fish species of central California include northern anchovy, albacore tuna, jack mackerel, Pacific mackerel, Pacific bonito, Pacific sardine, Pacific whiting, Pacific herring, salmon, steelhead trout and sharks. Most of these species are widely distributed in the area, and it is unlikely that an oil spill will harm enough individuals, their prey or habitat to significantly decrease these populations. However, northern anchovy are of concern since their restricted distributions during parts of their life cycle make them vulnerable to impacts from spilled oil. Another species that is abundant in the epipelagic zone and vulnerable to impacts is the market squid. Although squid are widely distributed offshore during most of their life cycle, they congregate inshore in very large numbers during spawning. Monterey Bay is one of the most important spawning areas in the state.

Both rocky and sandy shallow habitats are at risk from spilled oil when it comes ashore. Various species of abalone are, where they occur, especially at-risk members of the shallow rocky habitat. Currently, all major species of abalone in the central California area are severely depleted. Their depleted condition and life histories make abalone in shallow habitats especially vulnerable (at the population level) to impacts from spilled oil.

As oil comes on shore, the rocky intertidal habitat as well as coastal wetlands and mud flats adjacent to river mouths are at significant risk both from the beached oil and from most of the cleanup procedures used to remove the oil. Of special concern in the coastal marsh/wetland areas is the potential for oiling many species of resident or visiting birds, mammals, young-of-the-year endangered Coho salmon, and steelhead trout.

B.4 Los Angeles (north and south)



The Los Angeles (north and south) dispersant use pre-approval area includes all waters seaward of the 3-mile state waters line (shown in red), shoreward of the 200-mile line (shown in green) and outside the Channel Islands National Marine Sanctuary (shown in magenta). Areas inside state waters or National Marine Sanctuaries are "RRT Approval Required"; RRT approval will be case-specific.

Seabirds off California are generally most abundant in nearshore waters over the continental shelf; abundance drops off dramatically over the continental slope and deep offshore waters. High concentrations of seabirds occur in nearshore waters from Morro Bay to Point Arguello and the Santa Barbara Channel. Sea birds seasonally tend to concentrate near upwelling zones, in and "down stream" of offshore current jets associated with headlands, along temperature and salinity gradients, and along the shelf break. Both seabirds and marine mammals concentrate in these regions due to the high abundance of food.

Seabird densities are typically highest during the late summer through fall and winter periods (July through January) and lowest in April to June when birds are concentrated on their colonies. In general, seabird densities decrease when moving from the inshore to the offshore environment, dropping off considerably seaward of the continental shelf break.

Although over 100 species of seabirds have been reported from the region, the majority of individuals are composed of about 30 species. In the offshore waters (water depth > 200m), common seabird species occurring seasonally include sooty shearwaters, phalaropes, Leach's storm petrel, northern fulmar, black-legged kittiwake, gulls (herring, Bonaparte's, western and California), auklets (Cassin's and rhinoceros) and common murres. Nearshore (water depth <200m), common species include sooty shearwaters, phalaropes, common murres, loons, western grebes and western, California and Bonaparte's gulls. In addition, endangered species including brown pelicans, marbled murrelets (northern area of region), western snowy plovers, and least terns occur seasonally in the nearshore area and would be at risk from oil entering this area.

Breeding seabirds are especially vulnerable to oil spills. Seabird colonies occur on the Channel Islands and along the mainland from Pt. Conception north; few, if any, seabirds nest on the mainland south of Pt. Conception. The most common breeding species in this area include storm petrels (Leach's, ashy, and black), California brown pelican, cormorants (Brandt's, double-crested, and pelagic), western gulls and alcids (pigeon guillemot, Cassin's auklet, rhinoceros auklet). Although breeding seasons also vary from species to species, one or more species is generally conducting some aspect of reproduction (nest building, egg laying, chick rearing, etc.) from April through August. In 1989-1991, the total breeding seabird population of the project area was estimated at over 100,000 birds, representing about 16 percent of the total California seabird population.

Shorebirds are another important component of the avifauna of the Los Angeles-Long Beach area. More than 40 shorebird species have been recorded in central and southern California; however, many of these are extremely rare, and only about 24 species occur regularly in the area. Almost all shorebirds migrate to the area from northern breeding sites; very few shorebirds breed in this area. Although the majority of shorebirds occupy coastal wetlands, including estuaries, lagoons, and salt and freshwater marshes, they also occupy other coastal habitats, including sandy beaches and rocky shores. Common shorebird species in the area include black-bellied plover, willet, whimbrel, marbled godwit, black turnstone, sanderling, western sandpiper, least sandpiper, dunlin, and dowitchers. Breeding shorebirds are limited to black oystercatcher, black-necked stilt, American avocet, killdeer, and the threatened western snowy plover, which nests and winters on sandy beaches.

Because of their migratory nature and the fact that few breed in the area, shorebirds are most abundant from fall through spring; comparatively few shorebirds remain during the summer months. Important shorebird use areas include Mugu Lagoon, Santa Clara River mouth, Carpinteria Marsh, Goleta Slough, the Santa Ynez River mouth, and the Santa Maria River mouth. Shorebird densities are not available for these areas, but they are generally considered to be lower than heavily used areas, such as the San Francisco Bay. Although densities are not available, shorebirds occupying sandy beaches in nearby Ventura County averaged about 44 birds per linear kilometer of beach.

A number of marine mammal species are potentially at risk from spilled oil in this region of the coast. At least 34 species of marine mammals inhabit or visit California waters. These include six species of pinnipeds (seals and sea lions), 27 species of cetaceans (whales, porpoises, and dolphins), and the sea otter. Pinnipeds breed on the Channel Islands and on offshore rocks and isolated beaches along the mainland coast; thousands also move through the area during their annual migrations. Cetaceans, including a number of endangered species, use area waters as year-round habitat and calving grounds, important seasonal foraging grounds, or annual migration pathways. The sea otter, a year-round resident of the mainland coast north of Point Conception, is appearing in increasing numbers in the western Santa Barbara Channel and around the northern Channel Islands.

The threatened or endangered marine mammal species found in southern California waters include six whales (blue, humpback, fin, sei, right, and sperm whales), two pinnipeds (Guadalupe fur seal and Steller sea lion), and the southern sea otter. The two threatened pinniped species do not breed in the area and presently are uncommon in southern California waters.

Marine mammals vary in their susceptibility to the effects of oiling. Since oil can destroy the insulating qualities of hair or fur, resulting in hypothermia, marine mammals that depend on hair or fur for insulation are most likely to suffer mortality from exposure. Sea otters, which rely almost entirely on maintaining a layer of warm, dry air in their dense underfur as insulation against the cold, are among the most sensitive marine mammals to the effects of oil contamination. Most vulnerable to the direct effects of oiling among the pinnipeds are fur seals and newborn pups, which lack a thick insulating layer of fat. Cetaceans, which rely on layers of body fat and vascular control rather than pelage to retain body heat, are considered less vulnerable to the effects of oiling than pinnipeds.

Sea otters would be at high risk from an oil spill if oil were to reach nearshore waters of the region. Depending on the time of year, heavy oiling of intertidal and upland areas of the mainland coast could also threaten harbor seal and northern elephant seal pups. Similar contact to the northern Channel Islands, particularly San Miguel Island, could have significant impacts on California sea lion, northern fur seal, northern elephant seal, and harbor seal pups, and possibly on adult fur seals as well.

At least 554 species of California marine fishes inhabit or visit California waters. The high species richness is probably due to the complex topography, convergence of several water masses, and changeable environmental conditions. Point Conception is widely recognized as a faunal boundary with mostly cold-water species found to the north and warm-water species found to the south, though extensive migrations do occur as a result of fluctuating environmental conditions. In fact, warm- and cool-water events in the Southern California Bight (SCB) affect fish recruitment and can alter the composition of some fish assemblages for years. The SCB is located in the transition area between Pacific subarctic, Pacific equatorial, and North Pacific central water masses, and the fish fauna contains representatives from each of these sources. Of the 554 species of California marine fishes, 481 species occur in the SCB.

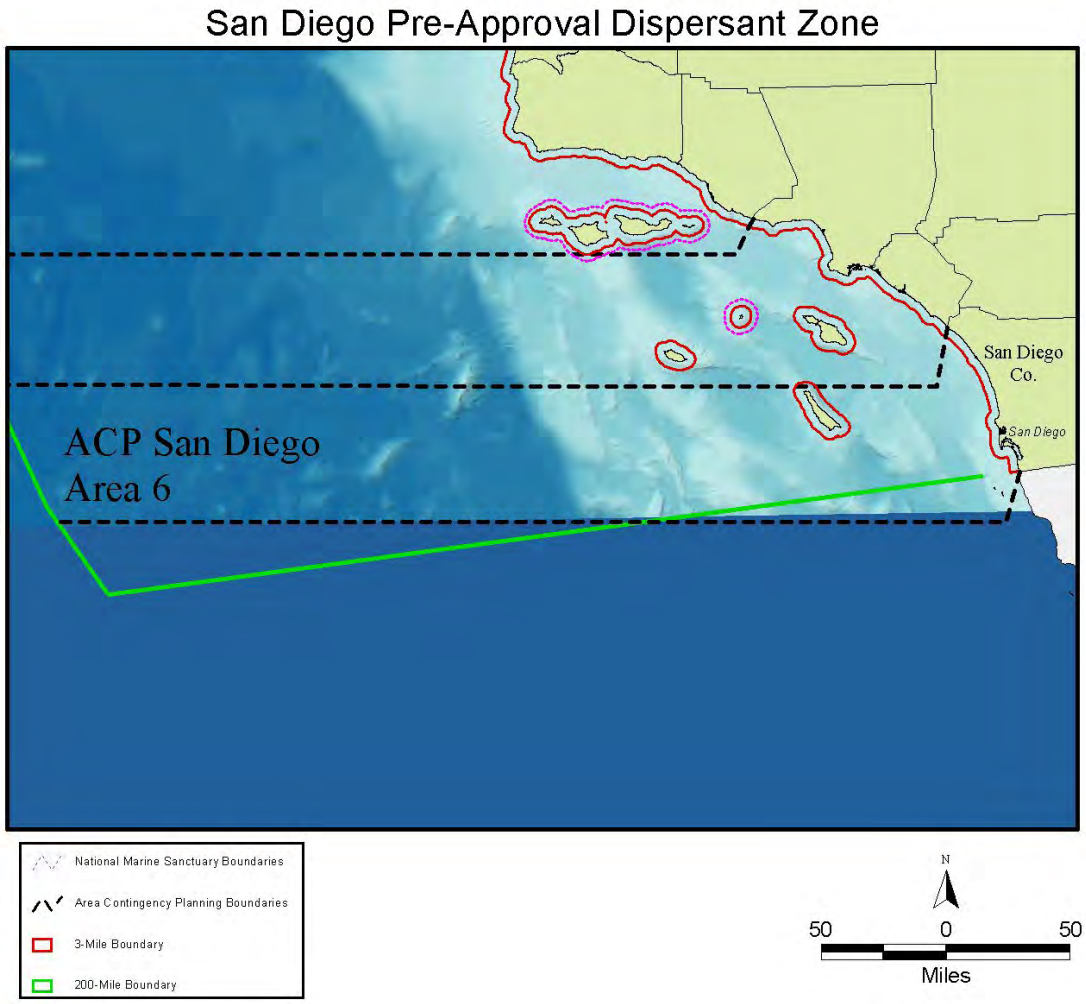
The pelagic realm is the largest habitat in the SCB and the home of 40 percent of the species and 50 percent of the families of fish. The pelagic zone includes the water column covering the shelf and the upper 150 to 200 m of water overlying the slope and deep basins. The fish from this zone represent a mix of permanent residents and periodic visitors. The important pelagic species of southern and central California include northern anchovy, albacore tuna, jack mackerel, Pacific mackerel, Pacific bonito, Pacific sardines, Pacific whiting, Pacific herring, salmon, steelhead trout, swordfish, and thresher shark. Most of these species are widely distributed in the SCB, and it is unlikely that an oil spill will harm enough individuals, their prey, or habitat to significantly decrease the population of a given species. However, northern anchovy are of concern since their restricted distribution during parts of their life cycle make them vulnerable to impacts from spilled oil. Another species that is abundant in the epipelagic zone and is vulnerable to impact is the market squid. Although during most of their life cycle squid are widely distributed offshore, squid congregate inshore in very large numbers during spawning. Monterey Bay and the northern Channel Islands are the most important spawning areas, but large spawning aggregations are known to occur along the entire coast from San Diego to Monterey.

Both rocky and sandy shallow habitats are at risk from spilled oil when it comes ashore. Abalone are an especially at-risk gastropod species of the shallow rocky habitat. Currently, all major species of abalone in

central and southern California are severely depleted. Their depleted condition and life histories make abalone in shallow habitats especially vulnerable (at the population level) to impacts from spilled oil.

As oil comes on shore, the rocky intertidal habitat, as well as coastal wetlands and mud flats adjacent to river mouths are at significant risk both from the beached oil and from most of the cleanup procedures used to remove the oil. Of special concern in the coastal marsh/wetland areas is the potential for oiling many species of resident or visiting birds, mammals, young-of-the-year endangered Coho salmon, and steelhead trout.

B.5 San Diego



The San Diego dispersant use pre-approval area includes all waters seaward of the 3-mile state waters line (shown in red), and shoreward of the 200-mile line (shown in green). Areas inside state waters or within 3 miles of the California-Mexico border are "RRT Approval Required"; RRT approval will be case-specific.

Oil spills within the offshore region initially threaten all seabirds and marine mammals that frequent the area. If the spilled oil is driven on shore by the sea conditions and prevailing winds, additional resources (*e.g.*, shorebirds, intertidal organisms, seal and sea lion pups) and their shoreline haulout, roosting, and nesting habitats are also at risk for oiling.

Seabirds off California are generally most abundant in nearshore waters over the continental shelf; abundance drops off dramatically over the continental slope and deep offshore waters. Sea birds seasonally tend to concentrate near upwelling zones, in and "down stream" of offshore current jets associated with headlands, along temperature and salinity gradients, and along the shelf break. Both seabirds and marine mammals concentrate in these regions due to the high abundance of food.

Seabird densities are typically highest during the late summer through fall and winter periods (July through January) and lowest in April to June when birds are concentrated on their colonies. In general, seabird densities decrease when moving from the inshore to the offshore environment, dropping off considerably seaward of the continental shelf break.

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Shorebirds are another important component of the avifauna of the San Diego area. More than 40 shorebird species have been recorded in central and southern California; however, many of these are extremely rare, and only about 24 species occur regularly in the area. Almost all shorebirds migrate to the project area from northern breeding sites; very few shorebirds breed in this area. Although the majority of shorebirds occupy coastal wetlands, including estuaries, lagoons, and salt and freshwater marshes, they also occupy other coastal habitats, including sandy beaches and rocky shores.

A number of marine mammal species are potentially at risk from spilled oil in this region of the coast. At least 34 species of marine mammals inhabit or visit California waters. These include six species of pinnipeds (seals and sea lions) and 27 species of cetaceans (whales, porpoises, and dolphins). Cetaceans, including a number of endangered species, use area waters as year-round habitat and calving grounds, important seasonal foraging grounds, or annual migration pathways.

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Marine mammals vary in their susceptibility to the effects of oiling. Since oil can destroy the insulating qualities of hair or fur, resulting in hypothermia, marine mammals that depend on hair or fur for insulation are most likely to suffer mortality from exposure. Most vulnerable to the direct effects of oiling among the pinnipeds are fur seals and newborn pups, which lack a thick insulating layer of fat. Cetaceans, which rely on layers of body fat and vascular control rather than pelage to retain body heat, are considered to be less vulnerable to the effects of oiling than pinnipeds.

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equatorial, and North Pacific central water masses, and the fish fauna contains representatives from each of these sources. Of the 554 species of California marine fishes, 481 species occur in the SCB.

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Both rocky and sandy shallow habitats are at risk from spilled oil when it comes ashore. Abalone are an especially at-risk gastropod species of the shallow rocky habitat. Currently, all major species of abalone in central and southern California are severely depleted. Their depleted condition and life histories make abalone in shallow habitats especially vulnerable (at the population level) to impacts from spilled oil.

As oil comes on shore, the rocky intertidal habitat, as well as coastal wetlands and mud flats adjacent to river mouths are at significant risk both from the beached oil and from most of the cleanup procedures used to remove the oil. Of special concern in the coastal marsh/wetland areas is the potential for oiling many species of resident or visiting birds, mammals, young-of-the-year endangered Coho salmon, and steelhead trout.

APPENDIX C

DISPERSANT EFFICACY AND AVAILABLE RESOURCES

C.1 Oils produced from California offshore platforms

Oil Field Name	Platform Name	Pacific Outer Continental Shelf Study	Minerals Management Service/EC Catalog	
		API Gravity	Name	API Gravity
Beta	Ellen Elly Eureka Edith	17.3 – 18.3	Beta	13.7
Carpinteria	Hogan Houchin Henry	24.2	Carpinteria	22.9
Dos Cuadras	Hillhouse A B C	24.3	Dos Cuadras	25.6
Hondo	Hondo Harmony	21.5	Hondo	19.6
Hueneme	Gina	20.9	Port Hueneme	
Pescado	Heritage	21.5		
Pitas Point	Habitat		Pitas Point	38
Point Arguello	Hidalgo Harvest Hermosa	22.2	Point Arguello Commingled Point Arguello Heavy Point Arguello Light	21.4 18.2 30.3
Point Pedernales	Irene	21.1	Platform Irene	11.2
Sacate				
Santa Clara	Gilda Grace	20.9	Santa Clara	22.1
Sockeye	Gail	21.6	Sockeye Sockeye Commingled Sockeye Sour Sockeye Sweet	26.2 19.8 18.8 29.4
			Platform Holly	11

From S.L. Ross, 2002

C.2 Some fresh oil properties of top ten oils shipped to California by tank ship, 1999-2001

Oil Type	Identifying Properties			
	API gravity	Sulfur content (%)	Viscosity at 15º C, cP	Pour point, ºC
Alaska North Slope	26.8	1.15	17	-15
Arab Medium	30.8	2.4	29	-10
Maya	21.8	3.3	299	-20
Arabian Light	33.4	1.77	14	-53
Oriente	29.2	1.01	85	-4
Basrah Light	33.7	1.95	20	-15
Escalante/Canadon Seco	24.1	0.19	?	?
Arabian Extra Light	37.9	1.2	?	?
FAO Blend	31.0	3.0	?	?
Yemen	31.0	0.6	?	?

C.3 Pacific OCS and imported California oils that have undergone spill-related testing and modeling

Crude oil name	API gravity	Fresh oil pour point (ºC)	Oil viscosity @ 15 ºC at various weathered states			Emulsion formation tendency	Dispersant "Window of Opportunity"
HIGHLY EMULSIFIABLE OILS (Emulsion forms at 0 to 10% oil evaporation)							
Arab Medium	29.5	-10	29	91	275	Yes @ 0%	Very narrow
Arab Light	31.8	-53	14	33	94	Yes @ 0%	Narrow
Hondo	19.6	-15	735	9583	449700	Yes @ 0%	Very narrow
Hueneme	14.8	-9	4131	20990		Yes @ 0%	Very narrow
Maya	21.8	-20	299	99390		Yes @ 0%	Very narrow
Oriente	25.9	-4	85		6124	Yes @ 0%	Very narrow
Pt. Arguello Commingled	21.4	-12	533	41860	2266000	Yes @ 0%	Very narrow
Pt. Arguello Heavy	18.2	-4	3250		4953000	Yes @ 0%	Very narrow
Pt. Arguello Light	30.3	-22	22	183	671	Yes @ 0%	Very narrow
Santa Clara	22.1	-3	304	1859	22760	Yes @ 0%	Very narrow
Sockeye	26.2	-12	45	163	628	Yes @ 0%	Very narrow
Sockeye Sour	18.8	-22	821	8708	475200	Yes @ 0%	Very narrow
MEDIUM EMULSIFIABLE OILS (Emulsion forms at 11 to 29% oil evaporation)							
Alaska North slope	26.8	-15	17	110	650	Yes @ 26%	Narrow
Carpinteria	22.9	-21	164	3426		Yes @ 11%	Narrow
Dos Cuadras	25.6	-30	51	187	741	Yes @ 11%	Narrow
Sockeye Sweet	29.4	-20	20	39	321	Yes @ 17%	Narrow
OILS THAT DO NOT EMULSIFY							
Diesel	39.5	-30	8	25	100	No	Very wide
Pitas Point	38.0	<-60	2		2	No	Very wide

Crude oil name	Hours for oil to reach specified viscosity in 10 kt winds and 15ºC water temperature					
	(Modeled) 1000 barrel batch spill (*i.e.*, from tank ship)			(Modeled) 10,000 barrel batch spill (*i.e.*, from tank ship)		
	2000 cP	5000 cP	20,000 cP	2000 cP	5000 cP	20,000 cP
HIGHLY EMULSIFIABLE OILS (Emulsion forms at 0 to 10% oil evaporation)						
Arab Medium	4.2	6.4	22.0	4.9	7.7	39.0
Arab Light	10.0	36.0	Disp @ 41 hrs	13.3	68.8	Disp @ 68 hrs
Hondo	2.0	3.0	5.5	2.4	3.7	6.2
Hueneme	0.0	0.5	1.9	0.0	0.5	1.9
Maya	1.6	2.3	4.8	1.8	2.6	5.1
Oriente	2.2	3.2	5.2	2.8	3.8	6.4
Pt. Arguello Commingled	1.6	2.6	4.3	1.7	2.9	4.9
Pt. Arguello Heavy	0.0	0.5	1.7	0.0	0.5	1.9
Pt. Arguello Light	4.4	6.9	23.0	5.1	8.1	42.0
Santa Clara	2.6	3.8	6.6	2.9	4.4	7.9
Sockeye	3.9	5.6	13.2	4.3	6.4	20.4
Sockeye Sour	1.1	1.9	3.1	1.3	2.0	3.5
MEDIUM EMULSIFIABLE OILS (Emulsion forms at 11 to 29% oil evaporation)						
Alaska North slope	37.9	39.7	43.3	60.7	62.2	66.7
Carpinteria	5.6	6.6	8.9	8.3	9.5	12.0
Dos Cuadras	5.4	7.0	11.0	7.4	8.9	14.3
Sockeye Sweet	8.6	10.6	28.8	11.6	14.1	47.8
OILS THAT DO NOT EMULSIFY						
Diesel	60.0	Disp @ 69 hrs		101.0	Disp @ 111 hrs	
Pitas Point	Disp @ 2.3 hrs			Disp @ 3.5 hrs		

The opportunity for using dispersants effectively on most oils listed above is limited. Only a few of the produced oils appear amenable to dispersion. However, if spill circumstances are right and response is very rapid, some success might be possible. The situation is different for the imported oils. Alaska North Slope crude, which represents about 50% of the oil spill risk from tankers in California, appears to be quite amenable to dispersion. Diesel oil, which is ubiquitous and therefore tends to be spilled relatively frequently, is also a good candidate.

From S.L. Ross, 2002

C.4 Description of general oil characteristics based on oil type

Type	Description	Characteristics	Crude oil examples	Refined product examples
I	**Light distillates** No need to disperse; oil will dissipate rapidly**.**	Specific gravity: <0.80 API gravity: >45 Viscosity: 0.5-2.0 cSt @ 15º C Non-persistent, very volatile, highly flammable, high evaporation rates, rapid spreading rates, highly toxic to biota, little if any emulsification, high penetration of substrate.	Algerian blend	Maui and Kapuni distillate, gasoline blendstocks, motor spirit (RMS/PMS), Avgas, Jet A1, kerosene
II	**Light crudes** Relatively non-persistent. Easily dispersed if pour point under 41º F; probably difficult to disperse if water temperature is below pour point (behaves like a Group IV oil).	Specific gravity: 0.80-0.85 API gravity: 35-45 Viscosity: 4 cSt to solid @ 15º C Non-persistent, moderate to high volatility, low to moderate viscosity, moderate to high toxicity, can form stable emulsions, moderate to high penetration of substrates.	Pour point <41º F: Brent, Ekofisk, Forties, Murban, Seria Light Pour point >41º F: Ardjuna, Beatrice, Camar, Lucina, Palanca, Angola, Pennington	Unfinished oils; automotive gas oil, marine gas oil, Navy gas oil
III	**Medium – heavy crudes, fuel oils** Fairly persistent, easily dispersed if treated promptly.	Specific gravity: 0.80-0.95 API gravity: 17.5-35 Viscosity: 8 cSt to solid @ 15º C Persistent, moderate volatility, moderate viscosity, variable acute toxicity, can form stable emulsions, low to moderate penetration of substrates.	Pour point < 41º F: Alaskan, Arabian light, Basrah, Dubai, Iranian heavy, Kuwaiti, Maya, Oriente Pour point > 41º F: Bonny light, Coban blend, Gamba, LSWR, Minas, Santa Cruz, Taching, Zaire	
IV	**Heavy crudes and residues** Fairly persistent, probably difficult to disperse if water temperature is below pour point of material.	Specific gravity: 0.9501.00 API gravity: 10.0-17.5 Viscosity: 1500 cSt to solid @ 15º C Persistent, low to moderate volatility, moderate to high viscosity, variable acute toxicity, can form stable emulsions, low to moderate penetration of substrates.		Heavy fuel oil, residues, Fletcher blend, Maui F sands < pour point, lube oils, lube oil blendstocks
V	**Non-spreading oils** Persistent, generally not dispersible	Specific gravity: >1.00 API gravity: <10.0 Viscosity: Solid unless heated Persistent, very low volatility, little if any evaporation, very high viscosity, very low acute toxicity, can form stable emulsions, little if any penetration of substrate.		Heavy bunker fuel oil, bitumen, very heavy fuel oil, asphalt, paraffins, waxes, residual fuels

In part from Cawthron, 2000

C.5 General California dispersant application platform information (information in this section is being updated)

Application method	Weather limitations	Advantages	Disadvantages
C-130/ADDS Pack	Winds: 30 – 35 kts Waves: 17 – 23 ft	Suitable for very large spills with longer (several day) time windows to accommodate the minimum 24-hour startup time. Greatest delivery capacity; might be capable of fully treating all of the oil spilled in a blowout spill and all oil in a 10,000 bbl batch spill.	At present the nearest ADDS Pack units are outside the state; start-up times may be lengthy; spraying not likely to begin until the second day of the spill; very expensive; requires runway.
DC-4		Suitable for very large spills with longer (several day) time windows to accommodate the minimum 24-hour startup time. The platform modeled is owned by Airborne Support Incorporated of Houma, LA; delivery capacity is approximately one-half that of the C-130 ADDS Pack.	Earliest this aircraft can begin spraying dispersant in California is probably the morning of the second day.
Single-engine planes (*e.g.*, Cessna AT-802 "Agtruck")	Winds: 17 – 21 kts Waves: 6 – 9 ft Ceiling: ≥1000 ft Visibility: ≥ 3 nm	Suitable for small- to mid-sized spills that occur at considerable distance from the response centers provided the time window is long enough to accommodate their slower startup time. Purpose-built for aerial spraying; capable of fairly short start-up time; a number of Agtrucks available for use in a large spill; other small planes may be relatively inexpensive.	Smaller payload; more limited range; not yet available in California, although one AZ operator may be under contract to CA OSRO; platform may not be available until beginning of the second day; limited to smaller spills; uses neat dispersant only
Medium-size helicopter	Winds: 17 – 27 kts Waves: 6 – 17 feet	Available; highly maneuverable; capable of being re-supplied near spill site; good operational efficiency; lands almost anywhere. Above sea blowouts from oil platforms (of oils with a <u>medium</u> emulsification rate) are good candidates for treatment by ship and helicopter platforms because they can remain on-scene and deliver dispersants constantly when needed. May be adequate to deal with small tanker spills close to their re-supply bases; could also respond to mid-sized spills provided the time window is long enough.	Limited by small payload and range; two are available in southern CA; use neat dispersant only. Blowouts of high emulsification rate oils will <u>not</u> be good candidates for dispersion from any platform type. Ship-based delivery may be limited by slow transit speed and small payload. These platforms are limited for spills at a distance from their base of operations, either because of slow transit speed or limited operating range. These limitations can be overcome in some circumstances by re-supplying them at or near the spill site.
Work boat	Winds: 7 – 21 kts Waves: 1 – 9 feet	Good control; mixes water. Above-sea blowouts from oil platforms (of oils with a <u>medium</u> emulsification rate) are good candidates for treatment by ship and helicopter platforms because they can remain on-scene and deliver dispersants constantly when needed. May be adequate to deal with small tanker spills close to their re-supply bases; could also respond to mid-sized spills provided the time window is long enough.	Moderate transit speed; only two ship-based systems (high-speed crew-cargo vessels) available in CA; limited to small spills; limited swath width. Blowouts of high emulsification rate oils will <u>not</u> be good candidates for dispersion from any platform type. Ship-based delivery may be limited by slow transit speed and small payload. These platforms are limited for spills at a distance from their base of operations, either because of slow transit speed or limited operating range. These limitations can be overcome in some circumstances by re-supplying them at or near the spill site.

From S.L. Ross, 2002

C.6 Characteristics of dispersant spraying platforms available to operators in California

Application system	Payload (gallons)	Pump rate (gpm)	Swath width (feet)	Average transit speed (knots)	Average				
					Start-up time (hours)	Spray speed (knots)	Repositioning time (minutes)	Resupply time (hours)	Range
C-130/ADDS-pack	5500	600	100	214	24	140	2	1	7 hours
DC-4 [a]	2000-2500	500	100	214	1	157	2	1	
Agtruck AT-802	800	120	80	200	4	140	0.5	1	200 miles
Agtruck AT-502	500	120	80	200	4	140	0.5	1	200 miles
Helicopter	150	79	80	90	1	50	0.5	0.25	1.75 miles
Vessel A [b]	1000	10	120	7	1	7	2	1	
Vessel D [c]	20,000	60	175	25	1	25	2	1	

[a] Values reported in the literature for aircraft logistic characteristics such as payload are somewhat variable. For the DC-4 payload, values range from 2000 to 2500 gallons. The value used in calculations is at the upper end of this range, 2500 gallons. It must be recognized that the payload of the existing DC-4 platform in the Gulf of Mexico area is somewhat lower than this at 2000 gallons.

[b] Modeled after Clean Seas boom type vessel spray system.

[c] Modeled after new portable single-nozzle spray system developed by National Response Corporation (NRC) and mounted on one of NRC's crew-cargo vessels. System characteristics are as follows:

- Payload: capacity is up to 20,000 gallons in the form of up to 10 2000-gallon DOT marine-portable tanks
- Pump rates: variable at 12, 25, 40 and 60 gallons per minute
- Swath width: range of nozzle varies with pump rate up to 70 feet @ 60 gpm, with one system on each side. Allowing for the 35' beam of the vessel, swath width is 140'
- Vessel speed: maximum speed is 25 knots

From S.L. Ross, 2002

C.7 Dispersant spraying capacity of platforms as a function of distance [a]

Platform	Operating distance (miles)	Number of sorties per day	Payload (barrels)	Volume of dispersant sprayed per day (barrels)	Volume of oil dispersed per day (barrels) [b]
C-130/ADDS Pack [c]	10	4	130.8	523.2	10464
	30	4	130.8	523.2	10464
	100	3	130.8	39234	7848
	200	3	130.8	392.4	7848
DC-4 [d]	10	6	47.6	285.6	5712
	30	5	47.6	238.1	4761
	100	4	47.6	190.4	3808
	200	3	47.6	142.8	2856
AT-802	10	8	18.9	151.2	3024
	30	7	18.9	132.1	2642
	100	5	18.9	94.4	1887
	200	3	18.9	56.6	1132
Helicopter	1	30	5.7	169.8	3396
	10	21	5.7	119.7	2394
	30	11	5.7	62.3	1245
Vessel [e]	1	3	23.8	71.4	1428
	10	2	23.8	47.6	952
	30	1	23.8	23.8	476
	100	1	23.8	23.8	476

[a] Based on response to a batch spill of 3180 m^3 (20,000 barrels).
[b] Assuming 20 volumes of oil are dispersed per 1 volume of dispersant sprayed.
[c] ADDS Pack specifications as per Biegert Aviation: Maximum reservoir capacity = 5500 gallons (20.8 m^3 = 130.8), recommended capacity = 5500 gallons (18.9 m^3).
[d] Values reported in literature for payload of DC-4 range from 2000 to 2500 gallons (7.5 to 9.5 m^3); value used here is 2000 gallons (= 47.6 barrels) as per ASI, Houma, LA.
[e] Modeled after Clean Seas boom type vessel spray system.

From S.L. Ross, 2002

C.8 Stockpiles of dispersant application resources in California and North America (This section is currently being updated)

MSRC OWNED AND CONTROLLED DISPERSANT INVENTORY

March 2008*

Prepared by the Marine Spill Response Corporation

#	Dispersant Owner/Controller	Location of Dispersant	Method of Storage (# of Containers)	Amount (gallons) Corexit 9500	Corexit 9527	TOTAL AMOUNTS (Gallons)
1	Marine Spill Response Corporation Rex Prosser (281) 776-4335 Office (832) 785-8169 Cell	Slaughter Beach, DE	330 gallon Tote (1)		330	330
2	Marine Spill Response Corporation Edison, NJ John Sweeney - (732) 346-2450 Pager - (800) 218-6261	Edison, NJ Linden Warehouse	330 gallon Totes (16) 55 gallon Drums (91)		4,605 5,005	9,610
3	Marine Spill Response Corporation Edison, NJ John Sweeney - (732) 346-2450 Pager - (800) 218-6261	Portland, ME - OSRV Perth Amboy, NJ - OSRV Chesapeake City, MD - OSRV Virginia Beach, VA - OSRV	350 gallon Tote (1) 350 gallon Tote (1) 350 gallon Tote (1) 350 gallon Tote (1)		330 330 330 330	1,320
4	Marine Spill Response Corporation Rex Prosser (281) 776-4335 Office (832) 785-8169 Cell	San Juan, Puerto Rico	330 gallon Totes (3)		900	900
5	Marine Spill Response Corporation Rex Prosser (281) 776-4335 Office (832) 785-8169 Cell	Stennis International Airport, MS	330 gallon Totes (58) ISO 5,000 gallons (1)		17,400 5,000	22,400
6	Marine Spill Response Corporation Mike Walker - (337) 475-6425 Pager - (888) 276-4246 Fax - (337) 475-6401	Miami, FL - OSRV Pascagoula, MS - OSRV Fort Jackson, LA - OSRV Lake Charles, LA - OSRV Galveston, TX - OSRV Corpus Christi, TX - OSRV	330 & 550 g Tote (1 ea) 330 & 550 g Tote (1 ea) 330 & 550 g Tote (1 ea) 330 & 550 g Tote (1 ea) 330 & 550 g Tote (1 ea) 350 gallon Tote (1)		880 880 880 880 880 330	4,730
7	Marine Spill Response Corporation Rex Prosser (281) 776-4335 Office (832) 785-8169 Cell	Oil Mop Inc. Houston, TX	330 gallon Tote (74)	22,200		22,200
8	Marine Spill Response Corporation Rex Prosser (281) 776-4335 Office (832) 785-8169 Cell	Coolidge Airport Coolidge, AZ	5,000 gallon ISO (1)		3,300	3,300
9	Marine Spill Response Corporation Long Beach, CA Ray Nottingham - (562) 981-7610 Pager - (954) 462-6467	Tesoro Marine Terminal Long Beach, CA Terminal Island, CA - OSRV	330 gallon Totes (36) 330 gallon Totes (2)	10,800	 605	11,405

Organization	Equipment types	Type of dispersant	Dispersant storage location	Quantity of dispersant (gallons)
Within California [a]				
Clean Seas Cooperative [c] 1180 Eugenia Place, Suite 204 Carpinteria, CA 93013 24-hr phone: 805-684-3838 Contacts: Jim Caesar Phone: 805-684-4392	<u>Boats</u> Mr. Clean & Mr. Clean III: 1000 gallons Corexit 9527 on board each vessel. Swath width for Mr. Clean is 105 ft, for Mr. Clean III is 115 ft; vessel calibration and dosage rate vary from speeds of 3 to 10 knots and dosage rates from 2 – 10 gal/acre. <u>Aerial (helicopter)</u> Storage 150 gal max; pumping rate 50 – 100 gal per minute; boom length 32 ft, swath 50 – 60 ft depending on speed; speed 50 – 100 kts; dosage rate 2, 3 or 5 gal per acre. <u>Yard Inventory (Corexit 9527)</u> (2) 5000 gal tankers = 10,000 (13) 550 gal tanks = 7150 (20) 55 gal barrels = 1100 (1) 500 gal tank = 500 Clean Seas also has 880 gals of shoreline dispersant (Corexit 7664) stored at yard.	Corexit 9527	Carpinteria, CA	20,750

C.8, continued Stockpiles of dispersants application resources in California and North America

Organization	Equipment types	Type of dispersant	Dispersant storage location	Quantity of dispersant (gallons)
Other North American Dispersant Stockpiles [e]				
Alyeska Pipeline Service Company P.O. Box 196660 Anchorage, AK 99519-6660 Phone: 907-278-1611		Corexit 9527 Corexit 9527	Anchorage, AK Valdez, AK	56,000 4,000
Clean Islands Council/State of Hawaii 179 Sand Islands Access Road Honolulu, HI 96819 Phone: 808-845-8465		Corexit 9527 Corexit 9500	Honolulu, HI Honolulu, HI	3,080 34,180
Clean Caribbean Cooperative 2381 Stirling Road Fort Lauderdale, FL 33312 Phone: 954-983-9880		Corexit 9527 Corexit 9500	Pt. Everglades, FL Pt. Everglades, FL	4,070 25,300
LOOP, Inc. 1 Seine Court New Orleans, LA 70114 Phone: 504-368-5667		Corexit 9527	Houma, LA	33,600
Clean Gulf Associates 1450 Poydras Street, Suite 1625 New Orleans, LA 70112 Phone: 888-242-2007		Corexit 9527 Corexit 9500	Houma LA Sugarland, TX	5,665 28,985
CISPRI (CIRO) 1392 Ocean Drive Homer, AK 99603 Phone: 907-235-6785		Corexit 9527 Corexit 9527	Niski, AK Anchorage, AK	9,295 11,275

C.8, continued Stockpiles of dispersants application resources in California and North America

Organization	Equipment types	Type of dispersant	Dispersant storage location	Quantity of dispersant (gallons)
Marine Spill Response Corporation **Clean Gulf Associates** 396 Roland Road Houma, LA 70363 Phone: 985-580-0924		Corexit 9527	Houma, LA	16,000
Airborne Support, Inc. 3626 Thunderbird Road Houma, LA 70363 Phone: 985-851-6391		Corexit 9527 Corexit 9500	Houma, LA Houma, LA	2,000 4,470
National Response Corporation 11200 Westheimer Road Houston, TX 77042 Phone: 713-977-9951 Houston, TX		Corexit 9527 Corexit 9500	Cameron, LA Morgan City, LA	1,540 220
Clean Sound Cooperative 1105 13th Street Everett, WA 98201 Phone: 425-783-0908		Corexit 9527	Blaine, WA	6,270
Delaware Bay & River Cooperative 700 Pilottown Road Lewes, DE 19958 Phone: 302-645-7861		Corexit 9527	Slaughter Beach, DE	1,650
Clean Harbors Cooperative 4601 Tremley Point Road Linden, NJ 07036 Phone: 908-862-7500		Corexit 9527	Lyndon, NJ	1,375
Nalco Exxon Energy Chemicals Hwy 42 North Kilgore, TX 75662 Phone: 903-984-1695		Corexit 9527 Corexit 9500	Sugarland, TX Sugarland, TX	Producer

[a] The amount of dispersant currently (2003) available in California is 42,310 gallons (1007 barrels), sufficient to treat 20,140 barrels of oil, assuming a 1:20 (dispersant:water) dilution ratio.

[b] Email communication, Steve Ricks (Clean Bay) to Ellen Faurot-Daniels (California Coastal Commission), 12/12/03.

[c] Email communication, Jim Caesar (Clean Seas) to Ellen Faurot-Daniels (California Coastal Commission), 11/25/03.

[d] mail communication, Ray Nottingham (Clean Coastal Waters) to Ellen Faurot-Daniels (California Coastal Commission), 12/02/03.

[e] Substantively from S.L. Ross, 2002. North American stockpile values are approximate because quantities change constantly. A portion of the 273,615 gallons (6514 bbls) could be made available for use on spills in California. Assuming a 1:20 dilution ratio, this quantity is sufficient for a spill of approximately 150,000 barrels.

Updated from Cawthron, 2000

C.9 Manufacturers of dispersant spray systems for boats, helicopters and fixed-wing aircraft

Dispersant spray equipment for boats, helicopters and fixed-wing aircraft are available from various manufacturers throughout the world. Table C.9 is a partial representative listing. Publications such as the *International Oil Spill Control Directory* and the *World Catalog of Oil Spill Response Products* have more complete listings that are periodically updated.

Dispersant application systems differ in design, capability, versatility, size, weight, ease of handling and control of dosage. Their suitability depends in part on the type of dispersant used. Concentrated dispersants such as Corexit 9500 and Corexit 9527 are generally most appropriate for modern spray equipment. A detailed description of application equipment requirements is presented in the 1997/1998 *World Catalog of Oil Spill Response Products*.

	Boats	Helicopters	Fixed-wing aircraft
ABASCO 363 West Canino Houston, Texas 77037 Phone: 800-242-7745	X	X	X
Ayles Fernie International, Ltd. Unit D5 Chaucer Business Park Kemsing, Seven Oaks, Kent TN15 6YU England Phone: 44/1732762962	X		
Biegert Aviation, Inc. 22022 South Price Road Chandler, Arizona 85245 Phone: 602-796-2400			X
CECA S.A. (Subsidiary of Elf Aquitane Group) Avenue Alfred Nobel – 64000 PAU France Phone: 33/559 92 44 00	X		
Helitask Bourne Airfield Cambridge CB3 7TQ England Phone: 44/954-210-765		X	
KU-SINTEF Group S.P. Andersens vei 15b N-7034 Trondheim, Norway Phone: 47 73 59 11 00		X	
KOLDA Corporation 16770 Hedgecroft, Suite 708 Houston, Texas 77060 Phone: 281-448-8995	X		X

C.9, continued Manufacturers of dispersant spray systems for boats, helicopters and fixed-wing aircraft

	Boats	Helicopters	Fixed-wing aircraft
KAAF Agro Aviation Les Jasses D'Albaron 13123 Albaror Arles, France Phone: 33/9071188		X	
Kepner Plastic Fabricators, Inc. 3131 Lomita Blvd. Torrance, California 90505 Phone: 310-325-3162	X		
Ro-Clean Desmi 21B Hestehaven DK5260, Odense S. Denmark Phone 45-65-910-201	X		
Simplex Manufacturing Company 13340 NE Whitaker Way Portland, Oregon 97230 Phone: 503-257-3511		X	
Slickbar Products Corporation 18 Beach Street Seymour, Connecticut 06483 Phone: 203-888-7700	X		
Transland, Inc. 24511 Frampton Avenue Harbor City, California 90710 Phone: 310-534-2511	X		
Vikoma International Ltd. Prospect Road Cowes, Isle of Wight PO31 7AD, England		X	

From ExxonMobil, 2000

C.10 Dispersant "Window of Opportunity"

(this section is currently under revision)

The "window of opportunity" for dispersant use is general defined as the timeframe that is generally available for application of chemical dispersants in which that application can be expected to be reasonably effective. It is often difficult to accurately predict the "window of opportunity" for any given dispersant application. As a result, the use of "rules of thumb" combined with "best professional judgment" often provides for the best results.

A number of factors will affect the efficacy of dispersant use and these factors with either expand or narrow a given "window of opportunity." In general, most dispersant formulations are designed to work in ocean water with an average salinity around 35 ppt. The efficacy of most salt water dispersant formulations drop off significantly as the ocean salinity decreases, such as in bays and estuaries during times of fresh water incursion. In general, heavier crudes are more difficult to disperse than lighter crude oils. Additionally, dispersant efficacy will vary based on the weathering of oils, most significant are emulsion formation and evaporation. A number of studies have been funded by the United States Minerals Management Service, evaluating the perimeters that contribute to the "window of opportunity" for dispersant use and have found that in many cases the "window of opportunity" may be extended. The information found in this section will be revised to address the latest scientific information. Currently, the information below provides good, albeit perhaps conservative, parameters regarding the "window of opportunity" for dispersant use. Additionally, at the time of an oil spill incident, the NOAA Scientific Support Coordinator can run several models estimating the "window of opportunity" for dispersant use. The mathematics in these models, however, may not take into account the latest scientific data and as a result, something the best means of determining if dispersants will be effective during an oil spill incident is to conduct field tests and visually monitor dispersant efficacy.

Type	Description & General Dispersability
I	**Light distillates** No need to disperse; oil will dissipate rapidly**.**
II	**Light crudes** Relatively non-persistent. Easily dispersed if pour point under 41º F; probably difficult to disperse if water temperature is below pour point (behaves like a Group IV oil).
III	**Medium – heavy crudes, fuel oils** Fairly persistent, easily dispersed if treated promptly.
IV	**Heavy crudes and residues** Fairly persistent, probably difficult to disperse if water temperature is below pour point of material.
V	**Non-spreading oils (sinking oils)** Persistent, generally not dispersible

GENERAL DISPERSABILITY RELATIVE TO API GRAVITY AND POUR POINT

Probably difficult or impossible to disperse	Medium weight material. Fairly persistent. Probably difficult to disperse if water temperature is below pour point of material.	Lightweight material. Relatively non-persistent. Probably difficult to disperse if water temperature is below pour point of material.	No need to disperse. Very light weight material. Oil will dissipate rapidly
	Medium weight material. Fairly persistent. Easily dispersed if treated promptly.	Lightweight material. Relatively non-persistent. Easily dispersed.	

API	17	34.5	45
Gravity	.953	.852	.802

Derived from information published by the International Tanker Owners Pollution Federation, Ltd., London (API 1986)

This table provides general guidance only. Note that specific dispersant formulations are designed to treat heavier, more viscous oils. Consult manufacturer recommendations prior to application and recommendations from monitoring team for continued use.

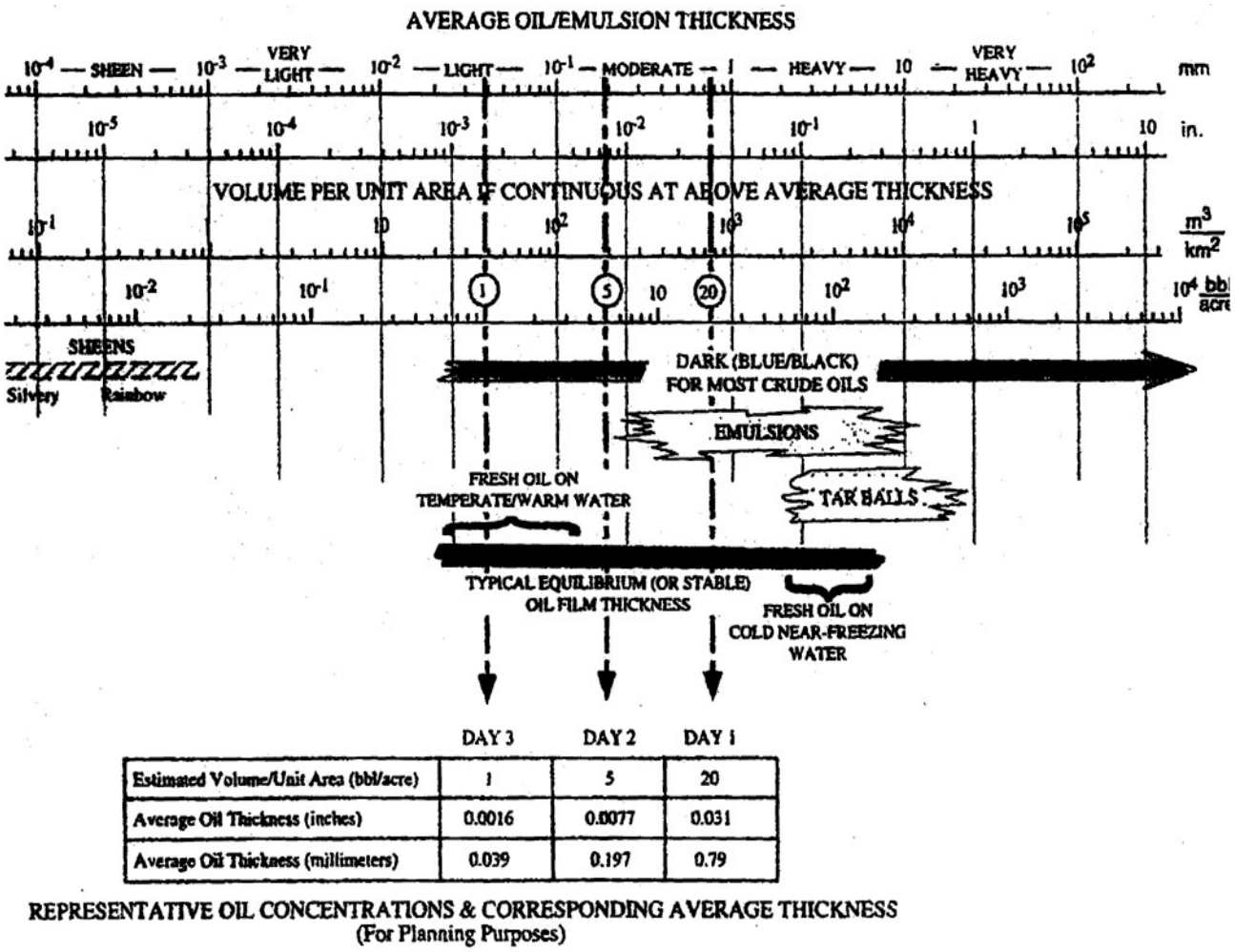
APPENDIX D

INSTRUCTIONS AND FORMS

D.1 Estimated dispersant dosages based on average oil thickness and dispersant-to-oil ratios

Average oil thickness **(inches)** (mm)	**Relative thickness**	**Dispersant-to-oil ratio (DOR)**						
		Oil concentration **(volume of oil/unit area)**	**1:1**	**1:5**	**1:10**	**1:20**	**1:50**	**1:100**
.0004 in (0.01 mm)	Very light to light	Gallons/acre	10.7	2.14	1.1	0.5	0.2	0.1
.001 in (0.02 mm)	Light	Gallons/acre	21.4	4.3	2.1	1.1	0.4	0.2
.002 in (0.05 mm)	Light	Gallons/acre	53.5	10.7	5.4	2.7	1.1	0.5
.004 in (0.1 mm)	Light to moderate	Gallons/acre	107	21.4	10.7	**5.4 ****	2.1	1.1
.019 in (0.5 mm)	Moderate	Gallons/acre	535	107	53.5	26.8	10.7	5.4
.04 in (1.0 mm)	Moderate to heavy	Gallons/acre	1070	214	107	53.5	21.4	10.7
.08 in (2.0 mm)	Heavy	Gallons/acre	2140	428	214	107	42.8	21.4
0.12 in (3.0 mm)	Heavy	Gallons/acre	3210	642	321	160.5	64.2	32.1

The 5 gallons/acre number was generated, assuming a light to moderate oil thickness and a DOR of 1:20. However, the table also makes it apparent that many other ratios may be appropriate depending on the volume or thickness of the spilled oil. How the oil behaves in the environment once it is spilled, and the dispersant application platform chosen, will also add a number of variables the FOSC will need to consider. Please see Discussion Note 9.1 for more information on slick thickness, oil volume, and dosage rate, as well as the figures in Appendices D.2 and D.3.



Estimated Volume/Unit Area (bbl/acre)	1	5	20
Average Oil Thickness (inches)	0.0016	0.0077	0.031
Average Oil Thickness (millimeters)	0.039	0.197	0.79

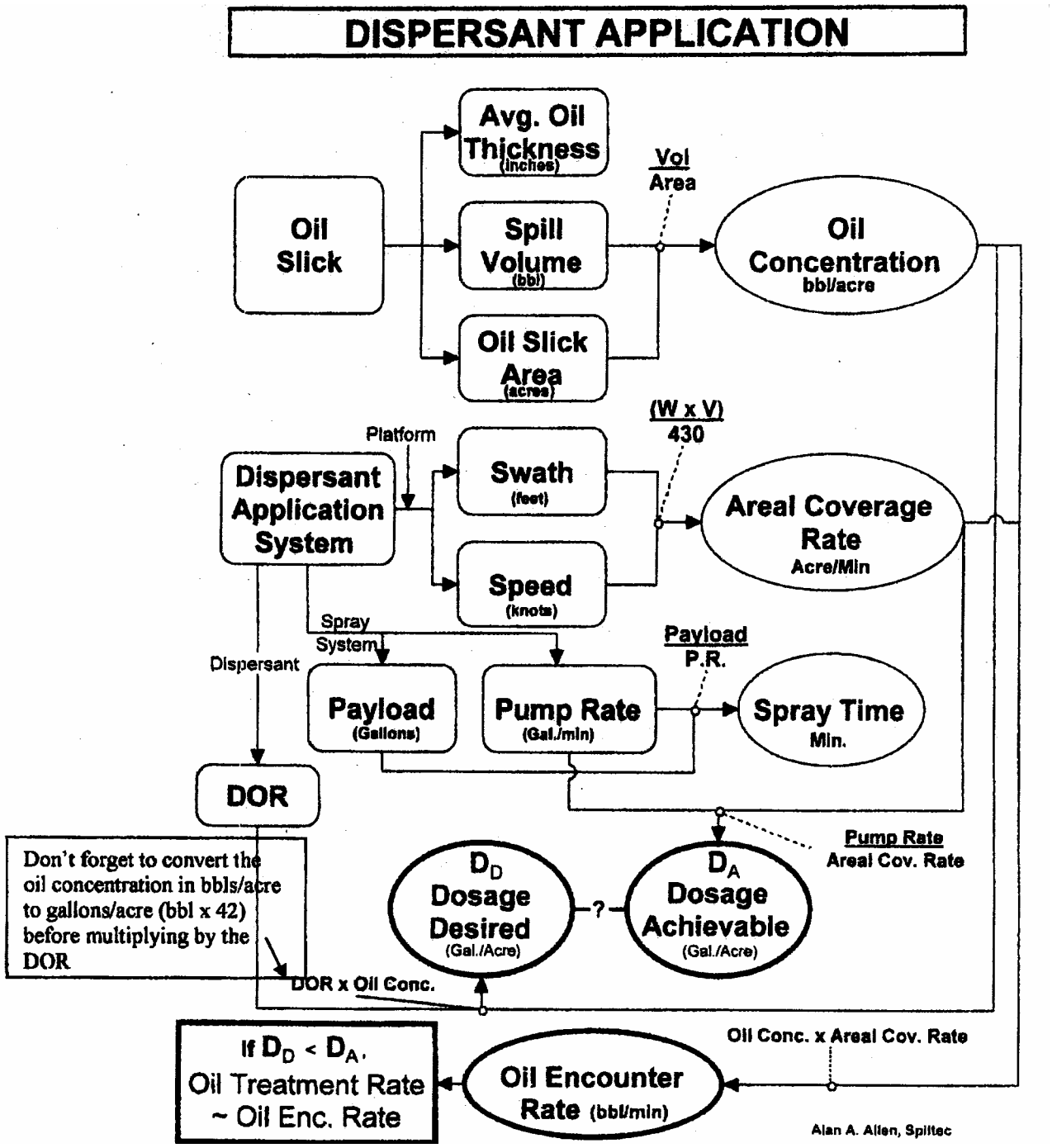
REPRESENTATIVE OIL CONCENTRATIONS & CORRESPONDING AVERAGE THICKNESS
(For Planning Purposes)

From Alan A. Allen (Spiltec), 2003 personal communication

D.2 Representative oil concentrations and corresponding average thicknesses

The circled numbers on the vertical lines in the figure above refer to 1, 5 and 20 barrels/acre as representative values for days 1, 2 and 3 following a significant crude oil spill.

D.3 Oil slick characteristics and DOR as they apply to the dispersant application system



D.4 Dispersant Application Summary Form

Incident name: _____ Report number: _____

This report made by: _____ Organization/agency: _____ Date: _____ Time: _____

Application parameters:

General location of application: _____

Size of target area: _____ (m^2/km^2/acres) Circle one

Volume of oil targeted: _____ (gal/bbl) Circle one
(from Dispersant Pre-Approval Assessment Form)

Dispersant: oil ratio used: _____

Volume of dispersant required: _____ (gal/bbl) Circle one
(calculate or use Appendix D.1)

Application platform:

Aircraft/Boat/Other: _____

Type: _____

Capacity: _____

Pump rate: _____

Swath width: _____

Application speed: _____

Diagram of application. Include scale, north arrow, location of oil, flight path and application location. Partition this box if multiple passes are expected so that each pass may be sketched.

Application capacity:

Distance to slick: _____

Base to spill return time: _____

Applications per hour: _____

Coverage per hour: _____

Application details:

Start time	Finish time	Total dispersant applied

In part from Cawthron, 2000

D.5 Monitoring dispersant effectiveness

Information in this section is based on the SMART (Special Monitoring of Advanced Response Technologies) Guidelines – a joint project of the U.S. Coast Guard, National Oceanic and Atmospheric Administration (NOAA), US Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention and the Minerals Management Service. Additional information is from the NOAA HAZMAT Report 96-7.

- It is essential to monitor the effectiveness of dispersant applications on oil dispersion.
- It is desirable to monitor the fate of oil, and to assess the impact of dispersed oil on the environment.
- Monitoring intensity should reflect spill size and prevailing conditions, as well as the potential effects of the spill, and logistical and physical constraints. Monitoring intensity should increase with spill size as follows:

Spill size	**Visual monitoring**	**Water column monitoring and sample collection** 1 m depth	multiple depths
Small	✔		
Medium	✔	✔	
Large	✔	✔	✔

- Visual observation of dispersant effectiveness is the minimum acceptable level of monitoring.
- Termination of dispersant operations should, wherever possible, be based on real-time on-site water column monitoring results from at least one depth.
- Monitoring at multiple depths (either with real-time data or samples collected for later analysis) will provide the best information on dispersant effectiveness and the fate of dispersed oil.

Mobilizing monitoring resources

- It is imperative that monitoring teams and technical advisors are notified of possible dispersant use, and are mobilized as soon as possible (see **Box 1a).**
- Dedicated monitoring staff should be appointed and should not be expected to perform other operational functions.

Visual observation

- Visual observation from aircraft is the most reliable technique for detecting and mapping oil distribution.
- General aerial observation objectives include mapping the distribution and appearance of the oil, verifying the modeled forecast of oil movement, providing responders with an overview of the incident, and directing cleanup operations.
- Observations should be made using the General Observation Guidelines (Appendix D.4), Dispersant Observation Checklist (Appendix D.5) and Dispersant Observation Report Form (Appendix D.6).
- Observations should be photographed and/or videotaped for comparison and documentation.
- Oil close to the coastline is best viewed from a helicopter, ideally with a door or window removed allowing the observer to look straight down on the oil.
- For oil further offshore, multi-engine aircraft provide a longer range, higher speeds and wider margin of safety.
- As a minimum, the aircraft should have space for two observers (excluding the pilot), visibility from both sides, pilot-observer communications, and sufficient navigational aids to follow the proposed flight path.
- Prior to take-off, the observer should be aware of aircraft safety procedures, be familiar with the general spill area, have appropriate maps or nautical charts to record spill details, and know the environmental conditions likely to be encountered.
- Visibility, surface wind speed and direction, and sea state are all important for predicting oil movement and interpreting visual observations. Poor viewing conditions (*e.g.*, fog, rain, or overwashing in rough seas) can prevent observers from seeing the entire spill. Strong winds could indicate emulsification rates may be more rapid than anticipated.
- Advanced sensing instruments (*e.g.*, infrared thermal imaging, side-looking airborne radar, laser fluorescence, microwave radiometer, infrared-ultraviolet line scanner, LANDSAT satellite systems) can provide a high

degree of sensitivity in determining dispersant effectiveness. Problems associated with each of these systems preclude their exclusive use during oil spills. Visual observations cannot always confirm that the oil is dispersed, and physical sampling of water beneath the slick may also be required.

Water column fluorometry and water samples

- Dispersant effectiveness can be confirmed in real-time by monitoring hydrocarbons in the water column using fluorometry.
- For medium and large spills, on-site monitoring is the preferred method for determining whether there is a significant difference between natural and chemical dispersion, and for deciding when dispersant operations should cease. It also provides the best means for determining the volume of chemically dispersed oil.
- Samples should ideally be collected at multiple depths from:
    - Water free of oil contamination (reference or control sites)
    - Water beneath the oil spill before dispersant application (pre-treatment)
    - Water beneath the oil spill after dispersant application (post-treatment)
- The time of sampling, instrument readings, relevant observations at selected time intervals and the exact position of each reading (preferably using Global Position System) must be recorded. Documentation of fluorometer calibration and verified instrument response should also be available.
- The sampling regime will depend on the availability of monitoring resources, the spill size and the logistical constraints of the response. At a minimum, sufficient samples are needed to characterize pre- and post-treatment differences relative to reference sites.
- As fluorometry measures natural fluorescence and not just oil, water samples should also be collected to allow fluorometry results to be related to measured oil concentrations. Fluorometry measures should be made using a continuous flow fluorometer. Water samples should be collected at the outlet port of the flow-trhough water duct, past the fluorometer cell. Water samples should be kept in a cool dark place prior to laboratory analysis.

Fate of dispersed oil

- Monitoring the track of the dispersed oil plume at several depths allows the dilution rate for the dispersed oil to be assessed, and the determination of the rate that hydrocarbon levels in the water column return to background levels.
- Trajectory models should be used where available to assist in tracking the plume. Dye markers can also be used.
- Oil fate monitoring requires:
    - Simultaneous monitoring from a single vessel using independent set-ups from at least two depths.
    - Collection of water samples to validate the fluorometer readings.
    - Wherever possible, measurement of water quality parameters (*e.g.*, temperature, conductivity, dissolved oxygen, pH, turbidity) to help explain the behavior of the dispersed oil.

Using and interpreting monitoring results

- Fluorometry readings will vary widely, reflecting the patchiness and inconsistency of the dispersed oil plume.
- Real-time data are essential if monitoring results are being used to guide dispersant operations and to determine when a response is no longer effective.
- An increase in the fluorometer signal trend beneath chemically dispersed oil of five times or greater than that of readings beneath untreated oil and reference sites is a good indication of dispersion occurring.
- It is important that actual oil concentrations are also measured so that the rate of natural dispersion can be compared to the rate of chemically enhanced dispersion, to determine the actual effect of dispersant use.

From Cawthron, 2000

D.6 General observation guidelines

- Wherever possible, use observers trained and experienced in identifying and quantifying oil floating on the sea;
- Use standard reporting terms (see below) and common guidelines to maintain consistency among observers.

STANDARD TERMS TO DESCRIBE OIL FLOATING ON THE WATER		
1	**Light sheen**	A light, almost transparent layer of oil. Sometimes confused with windrows and natural sheen resulting from biological processes.
2	**Silver sheen**	A slightly thicker layer of oil that appears gray, silvery or shimmers.
3	**Rainbow sheen**	Sheen that reflects colors
4	**Brown oil** (heavy or dull sheen)	Water-in-oil emulsion. Thickness typically 0.1 to 1.0 mm. Can vary depending on wind and current conditions.
5	**Mousse**	Water-in-oil emulsion. Colors can range from orange or tan to dark brown.
6	**Black oil**	Sometimes with a latex texture. Can look like kelp and other natural phenomena.
7	**Windrows** (fingers, stringers, streamers)	Oil or sheen oriented in lines or streaks. Brown oil and mousse can be easily confused with algal scum collecting in convergence lines, algae patches, or kelp.
8	**Tar balls**	Oil weathered into a pliable ball up to 30 cm. Sheen may or may not be present.
9	**Tar mats**	Non-floating mats of oily debris (usually sediment and/or plant matter) found on beaches or just offshore in shallow water.
10	**Pancakes**	Isolated patches of mostly circular oil (size range a few centimeters to 100s of meters in diameter). Sheen may or may not be present.

Oil on the water

- Oil is best viewed with the sun behind the observer, flying at a 30-degree angle to the slick.
- Mid-morning or mid-afternoon viewing is generally best, avoiding midday glare off the water and the limited contrast encountered in early morning or early evening.
- Overall spill dimensions are generally best viewed from an altitude of 1000-2000 feet.
- Estimating oil coverage and color are best from an altitude of 200-300 feet or less.
- Oil surface slicks and plumes can appear different for many reasons including oil or product characteristics, sun angles, viewing angles, type of observation platform, weather, light conditions, sea state, and dispersion rate.
- Waves, kelp beds, natural organics, pollen, plankton blooms, cloud shadows, jellyfish and algae can all look like oil under certain conditions.
- Low-contrast conditions (*e.g.*, overcast, twilight, haze) make observations difficult.

Dispersant applications

- May have variable effectiveness where different oil concentrations (spill thicknesses) result in variable oil/dispersant ratios being applied.
- May cause herding, temporarily "pushing" the oil together and making the slick appear to shrink, or to disappear from the sea surface for a short time.
- May change the color of an emulsified slick by reducing water content and viscosity.
- May change the shape of the slick, due to the de-emulsification action of the dispersant.
- May modify the spreading rates of oils (treated slicks can cover larger areas).

Dispersed oil plumes

- May not form immediately after dispersant application, especially if the oil is emulsified or there is low mixing energy.
- May not form or be visible at all.
- May be masked by surface oil and sheen or hidden by poor water clarity.
- May be mistaken for other things such as suspended solids.
- Are often highly irregular in shape and concentration.
- Can range in appearance from brown to white or cloudy.

Dispersant effectiveness

- A visible cloud in the water column indicates the dispersant is working
- Differences in the appearance of treated and untreated slicks indicate dispersion is likely.
- Boat wakes may physically part oil, falsely indicating successful dispersion.

D.7 Dispersant Observation Checklist

To be completed by dispersant observers on aircraft and vessels before departure

Incident name: _____ Report number:____

This report by: _____ Organization: _____ Date: _____ Time: _____

Observer name(s) and organizations: _____

_____

Observation platform: Helicopter / aircraft / boat / other (specify): _____

Application platform: Helicopter / aircraft / boat / other (specify): _____

COMMUNICATIONS

	VHF	UHF	Other
Air to air:	_____	_____	_____
Air to vessel:	_____	_____	_____
Air to ground:	_____	_____	_____
Ground to vessel:	_____	_____	_____
Vessel to vessel:	_____	_____	_____

	Aircraft/personnel names	Call sign	ETD to spill	ETA at spill
Sprayer 1:	_____	_____	_____	_____
Sprayer 2:	_____	_____	_____	_____
Spotter:	_____	_____	_____	_____
Observer:	_____	_____	_____	_____
Command Center:	_____	_____	_____	_____

DISPERSANT

Name: _____ Dispersant : oil ratio: _____

Application altitude (ft): _____ Dilution prior to application (if any): _____

Observation altitude (ft): _____ Application rate: _____

Circle one: gallons/acre, gallons/km^2, liters/hectare

WEATHER ❑ Sunny ❑ Overcast ❑ Cloudy ❑ Rain ❑ Fog

(Circle units used)

Sea state: _____ Wind speed: _____ knots Air temp: _____ ºF

Wave height: _____ ft Wind direction: _____ ºtrue/ºmagnetic Sea temp: _____ ºF

Water depth: _____ft Current speed: _____ knots Salinity: _____ ppt

Visibility: _____nm Current direction: _____ ºtrue/ºmagnetic Tide: _____(flood/ebb/slack)

DISPERSANT OBSERVATION EQUIPMENT AND SAFETY CHECKLIST

Observation

- Basemaps, charts
- Clipboard, notebook, reporting forms, checklists
- Pens, pencils
- GPS, spare batteries
- Job aids for visual observation
- Camera, spare film
- Video camera, spare batteries
- Binoculars

Personal safety

- Lifejacket (and exposure suit if required)
- Survival equipments (*e.g.*, flares, locator beacon)

Safety brief

- Safety brief with pilot/skipper
- Purpose of mission
- Operational constraints
  - Area orientation, observation plan
- Trip duration
- Landing or mooring sites
- Radio frequencies and reporting schedule
- Safety features (*e.g.*, emergency locator beacon, fire extinguishers, first aid kit, radios)
- Emergency exit procedures
- Gear deployment (*e.g.*, current drogue, dye)

From Cawthron, 2000

D.8 Dispersant Observations Report Form

For recording dispersant observations from aircraft and vessels

Incident name: _____ Report number:____

This report by: _____ Organization: _____ Date: _____ Time: _____

Application start time: _____ (military time) Viewing difficulties (if any): _____
Application finish time: _____ (military time) _____

VISUAL APPEARANCE OF SLICK (use standard definitions and visual guides of oil on water)

Before application	Immediately after application	20 minutes after application
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
Film roll #: _____	Film roll #: _____	Film roll #: _____
Photo #: _____	Photo #: _____	Photo #: _____

Dispersion cloud observed? ❑ Yes ❑ No Did oil re-appear (re-coalesce)? ❑ Yes ❑ No
Time taken for cloud to form: _____ minutes Time taken to reappear: _____ minutes

% of slick treated: _____
% overspray: _____
Estimated % efficiency: _____

Describe any variation in effectiveness across slick:

Describe differences between treated and untreated areas:

Describe any biota present and any effects observed:

General comments/problems encountered:

Recommendations for future applications:

Start position
Latitude: _____ north
Longitude: _____ west
Distance from shore: _____ miles

Finish position
Latitude: _____north
Longitude: _____ west
Distance from shore: _____ miles

From Cawthron, 2000

D.9 Wildlife Aerial Survey Form

Incident name: ____ Survey #: ____ Flight # ____

Date: ___________ Survey page ____ of ____

Survey Crew: ____ Survey Equipment: _______________________________

____ _______________________________

____ _______________________________

____ _______________________________

Flight information:

Aircraft type: _________________________________

Start flight local time: ___________

End survey local time: ___________

End survey local time: ___________

End flight local time: ___________

Survey altitude range (ft): ___________

Physical conditions:

Wind (kts): _________ from direction: _____________

Cloud cover (%): _________ Seastate (wave height): _____ ft

Overall sighting conditions:

☐ Excellent ☐ Very good ☐ Good

☐ Fair ☐ Poor

Sighting #	**Sighting specifics**			**General location**
	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
	Current altitude (ft):			
Comments:				

Wildlife Aerial Survey Form, continued

Incident name: ____ Survey #: ____ Flight # ____
Date: ___________ Survey page ____ of ____

Sighting #	Sighting specifics			General location
	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Comments:				

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APPENDIX E

WILDLIFE SPOTTING AND MONITOR PROTOCOLS
TRUSTEE MONITORING DURING DISPERSANT OPERATIONS

The primary purpose of the trustee wildlife spotter (TWS) is to monitor dispersant operations and provide confirmation that dispersant application operations are being conducted in accordance with the policies and procedures for wildlife protection outlined in the dispersant use plan. Specifically, the trustee wildlife spotter is to ensure that:

1) dispersants will not be applied directly to marine mammals within or outside of an oil slick:

2) dispersants will be applied in such as way as to avoid, to the maximum extent practicable, the spray of seabirds outside of the oil slick are being treated

3) if sea birds and/or marine mammals are present in the dispersant application area, the application of dispersants will be dictated by the first two stipulations.

Although it is the commitment of the RRT that wildlife trustee spotters be used when at all possible, dispersant operations will not be unduly delayed should a trained spotter not be available prior to dispersant application.

The trustee agencies with responsibility for oil spill prevention and response will select one trustee wildlife designee that will observe dispersant application operations and will be located in the dispersant spotter aircraft. It is the role of the trustee wildlife spotter to observe wildlife and assist the dispersant spotter and pilot avoid spraying of wildlife, making notes as necessary and appropriate to document the operation. If inadvertent spraying of wildlife occurs, the trustee wildlife spotter should make a note of this (including number of animals, species and location if possible) and include this information in his/her report to the Unified Command at the end of each dispersant operation. If at any time dispersant operations are not being conducted in accordance with the California Dispersant Plan, the trustee wildlife spotter should report back immediately to the Unified Command.

The trustee wildlife spotter should be properly trained to fulfill the functions required. Such training shall include:

1) Identification of marine birds and mammals from an aircraft, with special emphasis on species of concern during a dispersant operation;
2) General knowledge of dispersant application policies and procedures and annual training and coordination with operational personnel tasked with dispersant spotting in California;

3) General knowledge and understanding of the Incident Command System; and,

4) General aviation and safety knowledge.

E.1 Wildlife Aerial Survey Form

Incident name:_____ Survey #: _____ Flight # _____
Date: _____ Survey page ____ of _____

Survey Crew: _____ Survey Equipment: _____
_____ _____
_____ _____
_____ _____

Flight information:
Aircraft type: _____
Start flight local time:_____
End survey local time: _____
End survey local time: _____
End flight local time: _____
Survey altitude range (ft): _____

Physical conditions:
Wind (kts): _____ from direction_____
Cloud cover (%): _____ Seastate (wht): _____ ft

Overall sighting conditions:
☐ Excellent ☐ Very good ☐ Good
☐ Fair ☐ Poor

Dispersant Spraying Operations:

It is the policy of the RRT that the following stipulations apply for any dispersant use application:

1) dispersants will not be applied directly to marine mammals within or outside of an oil slick:

2) dispersants will be applied in such as way as to avoid, to the maximum extent practicable, the spray of seabirds outside of the oil slick are being treated

3) if sea birds and/or marine mammals are present in the dispersant application area, the application of dispersants will be dictated by the first two stipulations.

Where dispersant use operations in accordance with these stipulations: ☐ yes ☐ no
If no, please elaborate _____
_____
_____
_____
_____
_____

Wildlife Sighting:

Please note any observed wildlife in the grid below. Provide this information to the Resources at Risk Unit.

Sighting #	**Sighting specifics**			**General location**
	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			

Sighting	Number of animals:	Lat:	Taxa	
	Local time:	Long:	Species/ancillary ID info	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Comments:				

E.2 Sample Wildlife Aerial Survey Form

Incident name: *Santa Barbara Mystery Spill 34* Survey #: *1* Flight # *1*
Date: *11Dec03* Survey page *1* of *1*

Survey Crew: *Amelia Aviator -- pilot*
Joe Computer – data recorder
Bill Byrd – wildlife spotter
Olivia Oyle – dispersant spotter

Survey Equipment: *7 x 50 binoculars*
Garmin GPS
Digital camera
Tape recorder

Flight information:
Aircraft type: *Partenavia fixed-wing*
Start flight local time: *1400 PST*
End survey local time: *1415 PST*
End survey local time: *1510 PST*
End flight local time: *1530 PST*
Survey altitude range (ft): *400-1000 ft*

Physical conditions:
Wind (kts): *10-15* from direction: *NW*
Cloud cover (%): *ave. 60%* Seastate (wave height): *1-2* ft

Overall sighting conditions:
☐ Excellent ☐ Very good ☐ Good
☐ Fair ☐ Poor

Dispersant Spraying Operations:

It is the policy of the RRT that the following stipulations apply for any dispersant use application:

1) dispersants will not be applied directly to marine mammals within or outside of an oil slick:

2) dispersants will be applied in such as way as to avoid, to the maximum extent practicable, the spray of seabirds outside of the oil slick are being treated

3) if sea birds and/or marine mammals are present in the dispersant application area, the application of dispersants will be dictated by the first two stipulations.

Where dispersant use operations in accordance with these stipulations: ☐ yes ☐ no
If no, please elaborate:_____
_____
_____
_____

Wildlife Sighting:

Please not any observed wildlife in the grid below. Provide this information to the Resources at Risk Unit.

Sighting #	Sighting specifics			General location
1	Number of animals:*12*	Lat: *34 23.22 N*	Taxa: *Avian*	*NE corner of spill, 100m from leading edge*
	Local time: *1430*	Long: *119 43.23 W*	Species/ancillary ID info: *Brown pelicans*	
	Current altitude (ft): *450*			
Sighting	Number of animals: *300*	Lat: *34 24.11 N*	Taxa: *Unknown*	Center of spill, in oil
2	Local time: *1000*	Long: *119 33.87 W*	Species/ancillary ID info: *UNID small cetaceans*	
	Current altitude (ft): *1000*			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	

E.3 List of experienced aerial wildlife observers

This list is drawn in part from the List of Wildlife Experts and Contractors from Appendix 1b of the Wildlife Response Plan, a stand-alone response resource to use with each of California's Area Contingency Plans. Individuals excerpted from that list are those with aerial wildlife observation experience. Others listed are known to the response community as also having the requisite aerial observation skills and potentially available to help implement the Wildlife Observation Protocols during a dispersant response.

We offer here some of the same insights and caveats found in the Wildlife Response Plan:

> "*In general, the listing is divided into marine birds and marine mammals [experts}, with a few having expertise in near shore terrestrial animals. The list includes individuals who have a history of cooperation with [the California Department of Fish and Game] CDFG (other than individuals already known ... through the Oiled Wildlife Care Network – OWCN). It includes both agency personnel and private consultants statewide. This list is not comprehensive; some qualified individuals or companies may not be included. This list is not an endorsement of the ability of the personnel shown.*
>
> *This list was generated as a resource to [the Office of Spill Prevention and Response] OSPR field responders to aid in addressing wildlife issues and environmental sensitivities during spill response. Individuals on this list may be valuable to a spill response in many ways. For example, 1) local experts will often have site-specific knowledge (e.g., status of local populations, breeding status, abundance, seasonal occurrence) which will be necessary for effective spill response planning, 2) agency personnel shown can assist by recommending individuals from this list or others that may not be listed who may also be willing to participate in the response, 3) staffing Wildlife Reconnaissance functions, and 4) endangered species consultation and monitoring.*
>
> *Generally, all personnel listed, other than agency personnel, have indicated an ability to travel and work statewide. Spills involving endangered species and/or marine mammals will require special expertise. Non-agency affiliated personnel who are shown having expertise with listed species and marine mammals generally have permits and/or MOUs with CDFG, USFWS and/or NMFS."*

While these observers have the training and approvals necessary to assist in wildlife surveys during an oil spill response, they have not yet been separately briefed, pre-trained or vetted relative to the more particular needs of implementing the Wildlife Aerial Observation Protocols during a dispersant application.

This is a preliminary list that will be updated once experienced observers have been identified, trained in the specific dispersant-related Wildlife Observation Protocols, and vetted by the responsible federal and state trustee agencies. This list below is offered for the interim.

E.3 List of wildlife experts potentially able to assist in dispersant-related implementation of the WILDLIFE OBSERVATION PROTOCOLS (THIS DOCUMENT IS CURRENTLY BEING UPDATED)

Name (* Info not verified)	Specialty/Geographic Area Covered	Agency/Company/ Organization	Contact Numbers
Adams, Josh	Seabird capture, handling, ID, at-sea survey, radio telemetry, Monterey Bay to San Mateo county coast.	USGS	Work: 831-771-4422 Cell: Home: 831-684-9317 Emergency: home Email: Josh_Adams@usgs.gov
Ainley, David*	Seabirds, boat surveys	Harvey and Associates	Work: 408-263-1814 or 415-332-5718 Cell: Home: Emergency: Email:
Ames, Jack	Sea otters, oil spills, boat/shore/aerial sea otter surveys	CDFG-OSPR	Work: 831-469-1740 Cell: 831-212-7010 Pager: 408-939-5489 Home: 831-633-5294 Emergency: pager or cell Email: james@ospr.dfg.ca.gov
Anderson, Dan*	California brown pelican, waterbirds, pollution ecology	University of California	Work: 530-752-2108 Dept. office: 530-752-6586 Email:
Applegete, Tom	Shorebirds, California least tern, western snowy plover, waterfowl, SLO and Santa Barbara counties	Wildwing	Work: 805-764-2780 Cell: 805-235-1728 Home: Emergency: work or cell Email: wildwing@onemain.com
Boyce, Jennifer*	Seabirds, oil spills	NOAA, Restoration Center	Work: 562-980-4086 Cell: Home: Emergency: Email: Jennifer.boyce@noaa.gov
Burkett, Esther*	Marbled murrelet	CDFG-HCPB	Work: 916-654-4273 Cell: Home: Emergency: Email: eburkett@dfg.ca.gov
Colwell, Mark	Shorebirds, waterbirds	Humboldt State University	Work: 707-826-3723 Cell: Home: 707-822-7309 Emergency: home Email:
Copper, Elizabeth	California least tern	Avian Research Associates	Work: 619-435-1340 Cell: Home: Emergency: Email: ecopper@san.rr.com
Ford, Glenn	Seabirds	R.G. Ford Consulting	Work: 503-287-5173 Cell: 503-282-0799 Home: Emergency: Email: eci@teleport.com

E.2, continued List of wildlife experts potentially able to assist in dispersant-related implementation of the WILDLIFE OBSERVATION PROTOCOLS

Name (* Info not verified)	Specialty/Geographic Area Covered	Agency/Company/ Organization	Contact Numbers
Garrett, Kimball	Birds	Los Angeles County Museum of Natural History	Work: 213-763-3368 Cell: Home: Emergency: Email: kgarrett@nhm.org
Golightly, Rick	Seabirds, seabird colonies, oil spills	USGS-BRD	Work: 707-826-3952 Cell:530-304-4118 Home: Email: rtg1@humboldt.edu
Gorbics, Carol	Seabirds and sea otters. Alternate to Katy Zeeman.	USFWS	Work: 760-431-9940 x 214 Cell: 760-271-6934 Home: 760-804-3984 Emergency: Email:
Gress, Frank*	Seabirds, California brown pelican	CA Institute of Environmental study	Work: 530-756-6944 or 530-756-1175 Cell: Home: Emergency: Email; fgress@pacbell.net
Harvey, Jim*	Seabird and shorebird surveys, seabird and pinniped handling, marine mammals, Santa Cruz and Monterey counties	Moss Landing Marine Labs	Work: 831-632-4400 Cell: Home: Emergency: Email: harvey@mlml.calstate.edu
Haulena, Martin	Marine mammals and sea turtles, Mendocino to SLO counties	The marine Mammal Center	Work: 415-289-7370 Cell: 415-819-2254 Home: Email: haulenam@tmmc.org
Henkel, Laird	Aerial wildlife observation Seabird and shorebird surveys	CDFG-OSPR	Work: 831- 649-2880. Cell: 831-212-7665 Home: Emergency: home or cell Email: lhenkel@ospr.dfg.ca.gov
Hewitt, Ro	Western snowy plover, bird ID, local avifauna, California and southern Oregon	LBJ Enterprises	Work: 707-442-0339 Cell: phone 707 496 0854 Home: 707-269-0271 Emergency: home or cell Email: lbjent@humboldt1.com
Imai, Randy	Aerial wildlife observations, oil spill mapping and technology	CDFG-OSPR	Work: 916-324-0000 Cell: 916-826-5271 Pager: 916-360-2232 Home: Emergency: pager or cell Email: rimai@ospr.dfg.ca.gov
Jurek, Ron*	Snowy plover, least tern, shorebirds, birds, raptors	CDFG-HCPB	Work: 916-654-4267 Cell: Home: Emergency: Email: rjurek@dfg.ca.gov
Keane, Kathy	California least tern	Keane Biological Consultants	Work: 562-708-7657 Cell: 562-708-7657 Home: Emergency: Email: keanebio@yahoo.com

E.2, continued List of wildlife experts potentially able to assist in dispersant-related implementation of the WILDLIFE OBSERVATION PROTOCOLS

Name (* Info not verified)	Specialty/Geographic Area Covered	Agency/Company/ Organization	Contact Numbers
Kovacs, Karen*	Wildlife, waterbirds	CDFG-Eureka	Work: 707-445-6493 Cell: Home: Emergency: Email: kkovacs@dfg.ca.gov
LeValley, Ron	Waterbirds, marbled murrelet, snowy plover	Mad River Biologists	Work: 707-839-0900 Cell: 707-496-3326 Home: Emergency: Email:
Karl Mayer	Specialty/ Geographic Area: Sea Otters, marine mammals, land/ boat basedsea otter surveys, sea otter capture/ handling; Santa Cruz, Monterey, SLO counties	Monterey Bay Aquarium	Work phone: (831)644-7595 Cell phone: (831)915-2635 Email: kmayer@mbayaq.org
McAllister, Sean	Waterbirds, marbled murrelet, snowy plover, oil spills	Mad River Biologists	Work: (707) 442-4302 Cell: (707) 496-8790 Home: Emergency: Email: sean@madriverbio.com
McChesney, Gerry	Seabirds, seabird colonies, oil spills	USFWS, San Francisco Bay NWR	Work: 510-792-0717 Cell: Home: Emergency: Email:
Nevins, Hannah	Seabird and shorebird surveys, seabird and pinniped handling	Moss Landing Marine Labs	Work: 831-771-4422 Cell: Home: Emergency: home Email: hrnevins@hotmail.com
Ralph, C.J.	Marbled murrelet, seabirds, oil spills	US Forest Service	Work: 707-825-2992 Cell: Home: 707-822-2015 Emergency: Email: jcr2@homboldt.edu or cjralph@humboldt1.com
Roletto, Jan	Wildlife, marine mammals, oil spills	Gulf of the Farallones NMS	Work: 415-561-6622 Cell: home: Emergency: Email: j.roletto@noaa.gov

E.2, continued List of wildlife experts potentially able to assist in dispersant-related implementation of WILDLIFE OBSERVATION PROTOCOLS

Name (* Info not verified)	Specialty/Geographic Area Covered	Agency/Company/ Organization	Contact Numbers
Sharp, Brian	Waterbirds, oil spills	Sharp	Work: 541-763-2050 Cell: Home: Emergency: Email: ecoperspectives@yahoo.com
Singer, Steve	Marbled murrelet, birds	Singer	Work: 831-427-3297 Cell: Home: Emergency: Email:
Strong, Craig	Seabirds, shorebirds, special expertise with brown pelicans, waterfowl, marine mammals and marbled murrelet; west coast, San Diego-WA, Del Norte and Humboldt counties	Crescent Coastal Research	Work: 503-338-6023 Cell: 503-791-0509 Home: 503-338-5510 Emergency: home Email cstrong@pacifier.com
Swanson, Jim	Region 3 biologist	CDFG	Work: 707-944-5528 Cell: Home: Emergency: Email: jswanson@dfg.ca.gov
Sydeman, Bill*	Birds, oil spills	Point Reyes Bird Observatory	Work: 415-868-1221 Cell: Home: Emergency: Email: waterislife@hotmail.com
Tershey, Bernie	Seabirds	Island Conservation, Center for Ocean Health	Work: 831-459-1461 Cell: Home: Emergency: Email: tershey@islandconservation.org
Zeeman, Katy	Endangered species, wildlife, sea otters; Ventura through San Diego counties	USFWS	Work: 760-431-9440 x 291 Cell: Home: Emergency: Email: Katie_zeeman@fws.gov
Other Experienced Observers			
Boggs-Blalack, Melissa	Regional marine biologist, oil spills	CDFG-OSPR	Work: 805-772-1756 Cell: 805-558-1005 Pager: 805-614-2106 Home: Emergency: cell or pater Email: mboggs@ospr.dfg.ca.gov
Croll, Don	Seabird identification, surveys	University of California Santa Cruz, Center for Ocean Health	Work: 831-459-3610 Cell: Home: Emergency: Email: croll@biology.ucsc.edu
DeVogeleare, Andrew	MBNMS marine research director	Monterey Bay National Marine Sanctuary	Work: 831-647-4213 Cell: Home: Emergency: Email: andrew.p.devoglaere@noaa.gov

E.2, continued List of wildlife experts potentially able to assist in dispersant-related implementation of WILDLIFE OBSERVATION PROTOCOLS

Name (* Info not verified)	Specialty/Geographic Area Covered	Agency/Company/ Organization	Contact Numbers
Faurot-Daniels, Ellen	Land/boat/aerial sea otter surveys, oil spills, marine biologist, supervisor	California Coastal Commission	Work: 415-904-5285 or 831-427-4852 Cell: 831-334-2134 Pager: 415-201-5792 Home: 831-726-1750 Emergency: pager Email: efaurotdaniels@coastal.ca.gov
Harris, Mike	Land/boat/aerial sea otter surveys	CDFG-OSPR	Work: 805-772-135 Cell: 831-212-7090 Pager: 805-348-9316 Home: Emergency: cell or pager Email: mikeharris@ospr.dfg.ca.gov
Hatfield, Brian	Land/boat/aerial sea otter surveys	USGS-BRD	Work: 805-927-3893 Cell: 805-305-2121 Home: Emergency: Email: brian_hatfield@usgs.gov
Kenner, Mike	Land/boat/aerial sea otter surveys	USGS-BRD	Work: 831-459-3244 Cell: Home: Emergency: Email:
Kieckhefer, Tom	Cetaceans and sea otters	Pacific Cetacean Group and Friends of the Sea Otter	Work: 831-582-1030 or 831-373-2747 Cell: Home: Emergency: Email: kieckhefer@aol.com or education@seaotters.org
Kong, Corey	Los Angeles/Long Beach Area Environmental Scientist – Oil Spills	Dept. Fish and Game, Office of Spill Prevention and Response	Work: 562-598-6203 Cell: 562-477-7081 Pager: 562-400-4181 Home: Emergency: Email: ckong@ospr.dfg.ca.gov
Lewis, Robin	Regional marine biologist and supervisor, oil spills	CDFG-OSPR	Work: 858-467-4215 Cell: 619-972-0507 Pager: 619-893-2969 Home: Emergency: cell or pager Email: rlewis@ospr.dfg.ca.gov
Staedler, Michelle	Land/boat/aerial sea otter surveys	Monterey Bay Aquarium	Work: 831-648-4976 Cell: 831-594-7Pager: Home: Emergency: Email: mstaedler@mbayaq.org
Stewart, Julie	Land/boat/aerial sea otter surveys	Monterey Bay Aquarium	Work: Cell: 831-254-0949 Pager: Home: Emergency: Email: jstewart@mbayaq.org
Tinker, Tim	Land/boat/aerial sea otter surveys	UC Santa Cruz	Work: 831-459-2357 Cell: 831-254-9748 Pager: Home: Emergency: Email: tinker@biology.ucsc.edu

APPENDIX F

PUBLIC COMMUNICATIONS PLAN

F.1 Sample Press Release for use in the California Pre-Approval Zone

Attention: Proposed Use of Chemical Dispersants

In response to oil spill cleanup issues associated with the _____ oil spill incident, the Unified Command has given approval for the use of the chemical dispersant _____ to promote rapid oil dispersion into the surrounding water column during this incident and under the following conditions:

The dispersant use meets the "pre-approval zone" criteria as set forth in the California Dispersant Use Plan – Pre-approval zone checklist and as approved by the Region IX Regional Response Team, ensuring;

- the application of dispersants will be in the off-shore waters off the state 3 – 200 miles and not within a National Marine Sanctuary;
- the application of dispersants provides a net environmental benefit for species at risk from this oil spill and/or of species of special concern; and,
- the application of dispersants can be done safely and in accordance with standard marine and aviation practices.

As a part of the Unified Command's decision for dispersant use, federal and State Trustee Agencies **(list agencies, as necessary)** identified the (**list species of special concern in which dispersant use will potentially benefit**) as species of special concern and of significant risk of injury from this oil spill, especially if the spill were allowed to spread and hit sensitive habitats and shorelines. Wildlife and resource agencies believe that these species will be benefited by the use of dispersants and will monitoring the operations as appropriate for these species. (**provide any information, as necessary on fisheries and plans for any seafood tainting panels)**

In addition, dispersant use operations will be monitored by **(list the agencies; contacts of necessary**) using the methodology developed by the US Coast Guard (1999) Special Monitoring of Applied Response Technologies (SMART) protocols and as specified in the California Dispersant Use Plan. These protocols are designed to determine the effectiveness of dispersant use, thus providing a feed-back loop to the Unified Command for when operations should be terminated.

Close the press release with information on any press conferences or public meetings that will be held, where to get additional information, etc. . . and/or any telephone numbers of contact information that people can use.

FI.b. Oil Spill Dispersants: Frequently Asked Questions (FAQs)

1. Why are chemical dispersants used on an oil spill ?

Dispersants are used to minimize the environmental impact of an oil spill.

Dispersants *do not eliminate the problem of an oil spill* but are intended as a means of reducing the overall environmental impact of an oil slick at sea. Oil Spill Dispersant use accelerates the weathering and biological breakdown of oil at sea and *reduces the impact of oil on sensitive nearshore environments*.

Oil Spill Dispersants are also highly effective in *reducing exposure of sea birds and marine mammals to oil* as most sea birds are oiled by slicks on the surface of the sea or in near shore coastal habitats.

Undispersed slicks and residual oils are a persistent threat to nearshore, birds, mammals and intertidal communities due to the toxicity of, and contact with oil. Dispersed oil is less "sticky" than undispersed oil, therefore the adhesion and absorption onto surfaces and sediments of dispersed oil is greatly reduced compared with the original oil slick.

In a spill incident environmental trade-offs of protection and sacrifice will occur. These decisions are not taken lightly by response authorities and will be based on the best available advice and scientific data to achieve a net environmental benefit.

2. What are oil spill dispersants ?

Dispersants are chemical formulations with an active ingredient called surfactants. Surfactants are specifically designed chemicals that have both hydrophilic (water liking) and oleophilic (oil liking) groups in the chemical compound. These chemicals reduce the interfacial tension between the oil and water and helps the creation of small oil droplets, which move into the water column facilitating quicker natural biological breakdown (biodegradation) and dispersion. By decreasing the size of the oil droplets, and dispersing the droplets in the water column, the oil surface area exposed to the water increases and natural breakdown of the oil is enhanced. Thus removing the threat of the oil from the water surface to within the water column.

Dispersion is a natural process that occurs in surface slicks as wind and wave action break up the surface slick. However, naturally dispersed oil droplets tend to recoalesce and return to the water surface and reform as surface slicks. The additional of chemical disprsants allows the wind and wave action to then carry the small oil drolets away and dilut the concentration of the droplets in the water colum; these dispersed oil droplets are then targeted by indigenous oil-consuming microbes wehre they are broken down into the ultimate components, carbon dioxide and water.

3. On what basis is the decision made to use dispersants in a spill incident?

The main basis for decision making in determining whether oil spill dispersant will be used is:

" Will the application of the chemical dispersant to the spilled oil minimize the overall environmental impact of the oil spill?"

Except for the impact on marine birds and mammals, the most damaging effect of oil spills is when the oil strands on shorelines or enters restricted shallow waters like estuaries. Oil Spill Dispersants are a prime and vital response tool to stop oil coming ashore or from entering sensitive nearshore environments especially when weather and sea conditions do not allow the use of oil containment and recovery equipment.

Oil Spill Dispersants are usually not applied to oil spills in "near shore areas" for example: where sea grass beds, oyster beds, mariculture or coral reefs are present. However, dispersant use may be authorized by the Region IX Regional Response Team in these circumstances when there is a possibility of an impact of oil on a more sensitive nearhore habitat, or wildlife impacts are possible. For example, when an approaching oil slick may impact sensitive mammal breeding areas, or endangered species such as migratory birds.

4. What are the negative effects of dispersants on the environment ?

The acute toxicity of dispersed oil generally *does not reside in the dispersant* but in the more *toxic fractions of the oil*. Dispersing oil into the water in situations where there is little water movement or exchange, such as shallow embayments, increases exposure of subsurface, benthic organisms and fish to the toxic components of the oil.

Fish and other marine life in the larvae stage or juvenile stages are more prone to the toxicity effects of oil and dispersants. Therefore it is unlikely dispersants will be used near commercial fisheries, important breeding grounds, fish nurseries, shellfish aquaculture etc. unless it is to protect a more important environmental resource.

Seagrasses and coral reef communities are particularly sensitive to dispersed oil because instead of the oil "floating over" the reefs and submerged seagrass beds the oil/dispersant mixture in the water colour will *come into direct contact with these sensitive ecosystems.*

Generally there is a reluctance by spill responders to use dispersants in shallow waters less than 30 feet deep, although there may be situations where using dispersants could save nearshore impacts or wildlife.

5. Who authorizes the use of dispersants during an oil spill response?

Under the Oil Pollution Act of 1990, the Region IX Regional Response Team is vested with the authority over dispersant use for marine oil spills. Subpart J of the National Contingency Plan (NCP) provides that the Federal On-Scene Coordinator (FOSC), with the concurrence of the EPA representative to the Regional Response Team and the State with jurisdiction over the navigable waters threatened by the oil discharge, and in consultation with the U.S. Department of Commerce (DOC) and U.S. Department of the Interior (DOI) natural resource trustees, when practicable, may authorize the use of dispersants on oil discharges; provided, however, that such dispersants are listed on the NCP Product Schedule and licensed for use by the State of California.

The California Dispersant Use Plan outlines the process by which the Federal On-Scene Coordinator can undertake a dispersant use decision and provides the criteria to determine if a spill meets the requirements outlined by the RRT

for pre-approval of dispersant use. If all the pre-approval criteria is met, the FOSC can authorize the use of dispersants. If it is determined that a spill does not meet the pre-approval, then the final decision for a dispersant-use determination rests with the RRT

6. How effective are oil spill dispersants ?

Chemical dispersants aid the natural dispersion of oil by reducing the oil/water interfacial tension and, along with the natural motion of the sea, allow the break up of oil on the water into very fine droplets.

Effectiveness of oil dispersion by chemical dispersants at sea is governed by a range of conditions and include the:

type and chemistry of the oil,
degree of weathering of the oil,
the thickness of the oil slick,
type of dispersant,
droplet size and application ratio,
prevailing sea conditions (wave mixing energy), and
sea temperature and salinity.

7. Will dispersants work on all types of oils ?

No, dispersants will not work on all oil spills.

The first rule in combating oil spills with dispersants is that the oil must be amenable to dispersant use. It is also well understood by oil spill response agencies that *dispersants are only effective on certain types of oils* and the first priority is always to determine the spilled oil's physical and chemical properties in order to assess combat options.

It has been generally accepted that non-dispersable oils are;

non-spreading oils (pour point is higher than sea temperature), highly viscous oils (> 2000 Centistokes (cSt) - a measurement of the mobility of oil), a water-in-oil emulsion has formed (mousse).

A "rule of thumb" amongst spill responders as to whether or not a dispersant will work has historically been - "a dispersant may have a reasonable success rate if the oil is continuing to "flow" or spread as a fluid (not just sheening)".

Unfortunately this "rule of thumb" is only partly correct. The properties of these oils are determined by their chemical composition which vary widely. For the purposes of determining the use of dispersants at various sea temperatures the important properties are:

- the specific gravity (or API gravity),

- pour point, and
- viscosity.

Pour point and viscosity of a spilt oil are the dominant factors for the determination dispersant use. The California Dispersant Use Plan provides an outline of this information that can assist responders at the time of an oil spill incident

8. How quickly do we need to apply dispersants to an oil spill ?

As quickly as possible!

There is only a limited "window of opportunity" to use chemical dispersant in an oil spill incident. This is primarily due to the changing properties of the spilt oil due to weathering of the oil, but is also governed by the location and speed of movement of the slick onto the foreshores or into estuarine environments.

This window of opportunity may be as little as only a few hours. Sometimes if the conditions are favourable, a day or two.

Therefore it is essential that the capability exists to quickly activate and deploy resources anywhere across California to deliver and apply oil spill dispersants at sea.

9. What are the Health and Safety Issues Associated with the Use of Chemical Dispersants During An Incident?

Response workers must be careful to ensure that personnel do not get sprayed by the dispersants, or come in contract with any of the overspray. Vessels must only be deployed under safe sea conditions.

10. Are There any Waster Generation of Disposal Issues Associated with the Use of Chemical Dispersants?

Effective use of dispersant agents should signficatly reduce the amount of oil wastes generated.

F.2 General risk communication guidelines

- **Know the stakeholders**

  Identifying both external and internal stakeholders and finding out their diverse and sometimes competing interests and concerns is the first step to any successful risk communication effort. The best way to determine stakeholder interests and concerns is to ask them! Conduct interviews with key leaders both outside and inside your organization. Use the information gathered in this step to develop your risk communication program for establishing collaborative problem-solving and communication efforts.

- **Simplify language and presentation, not content**

  When trying to communicate the complex issues behind a health risk, it is easy to leave out information that seems to be overly technical. Risk communication research and studies have proven that all audience members can understand any technical subject if it is presented properly. This can be done, for example, through the use of visuals and diagrams and by defining all technical, medical and scientific jargon and acronyms.

- **Be objective, not subjective**

  It is often very easy to differentiate between opinions and facts. It can be difficult, however, to respond credibly to opinions without substantiating them or offending the individual asking the question. In order to maintain credibility, respond to both opinions and facts in the same manner.

- **Communicate clearly and honestly**

  To communicate clearly, present information at the audience's level of understanding. People can reject information that is too difficult for them or they can reject a communicator who is perceived to be dishonest or untrustworthy. As a result, they may refuse to acknowledge the information or become hostile. On the other hand, they may become hostile if they feel patronized. The bottom line is – know the audience! In addition, whenever possible, provide familiar examples and concrete information that can help put the risk in perspective.

- **Deal with uncertainty**

  When communicating health risks, results are not definitive. Discuss sources of uncertainty, such as how the data were gathered, how they were analyzed, and how the results were interpreted. This demonstrates that the uncertainties are recognized, which can lead to an increase in trust and credibility. However, when discussing uncertainty, the communicator should stress his or her expertise and knowledge of the subject. This will reinforce the leadership's ability to handle the situation and could allay concerns and fears regarding the risk and the risk-management decision.

- **Be cautious when using risk comparisons**

  In order to put risks in perspective, comparing an unfamiliar risk to a familiar one can be helpful. However, some types of comparisons can alienate audience members. Avoid comparing unrelated risks, such as the risks associated with smoking versus those associated with air contamination. People rarely accept the comparison of unrelated risk.

- **Develop key messages**

  Key messages are those items of importance, the health risk information that needs to be communicated. They must be clear, concise, and to-the-point. No more than three messages should be communicated at one time. Repeat key messages as often as possible to ensure they are not misunderstood or misinterpreted.

- **Be prepared**

  Most questions and concerns can be anticipated if the audience is known. In fact, the communicator should know 70 percent of the possible questions that could be asked. Consider how to answer general questions and how to respond to specific inquiries.

F.3 Risk communication guide for state or local agencies

Much of the following is excerpted from "Risk Communication Guide for State and Local Agencies", produced be the California state Office of Emergency Services (October 2001). The full copy of the report can be requested from Yvonne Addassi (OSPR; see Appendix A) or by accessing the following internet web site:

http://www.oes.ca.gov/oeshomep.nsf/all/RiskGuide/$file/RiskGuide.pdf

Key risk issues often of interest to the community

- Consequences of worst-case and alternative scenarios and the likelihood of disaster.
- Local government and community emergency response actions, and how those have been factored into state and federal response actions.
- Community notification systems.
- Perceived risks as reported by the media.
- Use of standards and accepted practices.
- Safety thresholds and limits.
- Acceptance of the decision process and decisions by the technical, scientific and environmental communities
- Other potential considerations (*e.g.*, business (including commercial fishing and tourism) and recreation (including fishing and beach access) impacts.

- Pay as much attention to community outrage factors, and to the community's concerns, as you do to scientific data. At the same time, do not underestimate the public's ability to understand technical information**.**

General risk perception and communication issues

- Risks under individual control are accepted more readily than those subject to industry or government control.

  At the time of an actual spill response and/or a decision to use dispersants, response actions will be directed by the Unified Command. It is important that during an oil spill emergency response, actions taken are quick, well-considered, yet nevertheless directive. To offset public unease at how heavy-handed this may seem, it will be helpful to briefly review how various stakeholder groups and the public were included in preceding dispersant response planning process, and how the current dispersant decision is being guided by real-time data gathering. Also include information on other agency consultations, and how particular concerns about living resources, fishery impacts, and socioeconomic impacts will be addressed.

- Risks that seem fair are more acceptable than those that seem unfair.

  It may be helpful to explain the Net Environmental Benefit Analysis process that was used in the response planning phase. At that time, it was determined that 1) harm would occur as a result of a spill, and 2) the goal is to minimize the overall harm and spare the most sensitive resources, and provide a net environmental benefit. However, the communicator will also need to address questions of impacts to business and coastal and ocean access, as these were not considered at the time that net environmental benefits were being weighed during the planning process.

- Risk information that comes from trustworthy sources is more readily believed than information from untrustworthy sources.

  Use the guidance offered above in Appendix F.2.

- Exotic risks seem more dangerous than familiar risks.

  Use of dispersants in California is not yet a common oil spill response practice. The public will expect to see that all other means to recover oil using the more traditional mechanical means have been considered. They also need to understand the circumstances under which dispersants may cause less harm to the environment than would those more traditional mechanical recovery tools, and how all means to recover and/or re-locate the oil to less sensitive environmental "compartments" will be used.

- Risks that are "undetectable" are perceived as more dangerous.

  It is extremely likely that the public will interpret a decision to use dispersants as a decision to "hide" the oil. These concerns need to be addressed openly and honestly, drawing on the communication tools in Appendix F.2 as well as the resource impact information generated during the dispersant Net Environmental Benefit Analysis response planning process.

F.3, continued

Possible objectives of a risk communication program

- Research the issues with stakeholders to gather sufficient information to identify the most important risk communication objectives to address.
- Identifying the stakeholders to anticipate or assess their varying interests, in order to design an effective risk communication program is a critical initial task.
- Stakeholders can include the residential, business, commercial or industrial communities, your agency and other agencies (local and state governments, special districts), environmental groups, and general interested members of the public. Media members may also be present.
- The level of stakeholder interest is a driving force in the assignment of risk communication priorities -- properly identifying and understanding all stakeholder objectives will enhance risk communication effectiveness.
- Communication objectives may include:
  - informing the community, seeking input or feedback, clarifying the probability and consequences of potential risks, addressing existing controversies or concerns, providing a forum for discussion, improving stakeholder understanding and support of government decisions, clarifying agency roles in controlling risk, coordinating federal and state emergency response plans with local government and business emergency response plans, and satisfying regulatory requirements to communicate risk.
- Potentially important objectives during and after the incident include:
  - retaining credibility and trust, clarifying how the current incident compares to the previously assessed risk, identifying how lessons-learned will be used to decrease risks and consequences in the future, and providing enhancements to future community emergency response.

Defining effective risk communication activities during and after incidents

- If an incident was noticed by or impacted the public, time is of the essence in providing information to the community.
- Several communication media (*e.g.*, newspapers, television, radio, technical journals) will be readily available, but not necessarily controllable.
- The community will gauge the success of the incident investigation efforts and control of causal factors by how much information is communicated to the community.
- If there is a high degree of uncertainty, focus the risk communication effort on what is being done to control the emergency. Keep the communication channels open.
- Contact news media to provide information. See "**Guidelines for meeting with the media**" below. If there is uncertainty with respect to event chronology or causes, release the information prudently and properly identify that the information is preliminary, but additional information will be provided as it becomes available.
- After an incident:
  - Ensure that any preliminary information has been verified, clarified or modified so that future references to the incident will be factual.
  - Follow-up with local and regional media to verify key information and provide a close-out mechanism for the spill response.
  - Be honest and candid with the public and media, using the guidelines in Appendix F.2.a

Choosing the right representatives

- Use field/community relations staff to relay community concerns within the agency.
- Choose carefully those who represent the agency, and provide appropriate support (e.g.
- Technically-qualified people should have a major role in risk communication.
- For effective communication, representatives need to address technical, communication and authority issues.
- If possible, use the same agency representative throughout the life of the event.
- In some situations, a non-agency representative may be more useful than someone from inside an agency.

Responding personally

- When you speak at a public meeting, tell people who you are, what your background is, and why you are there.
- When speaking personally, put your views into the context of your own values, and urge your audience to do the same.
- If your personal position does not agree with agency policy, do not misrepresent yourself or mislead the community.
- Prepare responses to potential questions before the meeting.

F.3, continued

Creating and maintaining trust and credibility during and after an incident

- Maintain open channels of communication.
- Provide critical information promptly.
- Ensure that the public receives a clear message that the emergency responders are taking appropriate actions to mitigate the event.
- Provide a resource for the public to call to secure additional information.
- Take appropriate steps to promptly investigate the cause of the event.
- Ensure that the public receives a clear message that an investigation of the incident was performed and appropriate actions to prevent a future incident were identified for implementation.
- Provide appropriate follow-up information and follow through with any commitments to the community.
- Recognize that people's values and feelings are a legitimate aspect of public health and safety issues and that such concerns may convey valuable information.
- When people are speaking emotionally, respond to their emotions. Do not merely respond with data.
- Be aware of your own values and feelings about an issue and the effect they have on you.
- Empathetic words will be effective only if your tone of voice, body language and demeanor reinforce what you are saying.

Guidelines for meeting with the media

- Be prepared. Plan what you want to say and anticipate reporter's questions.
- Take and keep control. You decide where to be interviewed. Bridge to your points or to turn negative questions into positive responses. Don't repeat negatives. Know when to exit the interview.
- Make your point. Bring your own agenda to the interview. Stress positive aspects of your operation.
- Keep your composure and watch your body language. Look and sound like you want to be there. Be cooperative, not combative. Avoid a defensive appearance.
- Don't speculate. If you do not have an answer, say so. Do not answer hypothetical questions. Do not feel all questions must be answered immediately.
- Never say "No Comment". Give sound reasons why you cannot answer a question (proprietary information, lack of authority, etc.).
- Never go "Off the Record". Anything you say may be reported. Do not be tricked into answering a question when a reporter says he has turned off a microphone or camera.

F.4 Planning a public meeting: Checklist

As discussed in Appendix F.3, public meetings are one way to involve the community stakeholders in your agency's spill response communications plan. They can be organized in many different ways, depending on the goal, topic, audience and other factors. This checklist will help with general elements that would apply to most public meetings.

PUBLIC MEETING CHECKLIST

MEETING PURPOSE

Organizations and individuals identified? ❑Yes ❑ No
Interests identified and categorized? ❑Yes ❑ No

Meeting time: _____
Date: _____
Hours: _____
Meeting place(s): _____
Address: _____
_____

Central location? ❑Yes ❑ No
Public transportation access? ❑Yes ❑ No
Suitable parking? ❑Yes ❑ No
Safe area? ❑Yes ❑ No
Adequate space? ❑ Yes ❑ No
Adequate facilities? ❑Yes ❑ No

Total expected:

General session planned? ❑Yes ❑No
Number of small groups/number in each:

Agenda questions developed? ❑Yes ❑No
Schedule developed? ❑Yes ❑No
Stakeholder interest topics included? ❑ Yes ❑ No
Speakers and speaker order identified? ❑Yes ❑ No

PUBLICITY

Methods selected: _____
_____
_____

Material prepared? ❑Yes ❑ No
Number of copies: _____
Material distributed? ❑Yes ❑ No
Personal follow-up? ❑Yes ❑ No
PIO/JIC contacted? ❑Yes ❑ No
Message developed? ❑Yes ❑ No
Message approved? ❑Yes ❑ No
Answers prepared? ❑Yes ❑ No
Press release issued? ❑Yes ❑ No

MEETING ARRANGEMENTS

Tables, chairs, lecterns obtained? ❑Yes ❑No
Audio/visual equipment obtained? ❑ Yes ❑No
Registration table? ❑Yes ❑ No
Name tags? ❑Yes ❑No
Refreshments? ❑Yes ❑ No
Heating & cooling OK? ❑Yes ❑ No
Sound & lights OK? ❑Yes ❑ No
Pens, pencils, flipcharts? ❑Yes ❑ No

INFORMATION DEVELOPMENT AND PRESENTATION

Information to be provided:

Written information completed? ❑Yes ❑ No
Role for moderator identified? ❑Yes ❑No
Moderator rehearsed? ❑ Yes ❑ No

RECORDING THE PROCEEDINGS

Methods:
Moderators:
Meeting evaluation tools:
Recommendations made? ❑Yes ❑No
Recommendations taken? ❑ Yes ❑No
Post-meeting report to public made? ❑Yes ❑ No

F.5 Dispersant fact sheet

Include in press packet, distribute at public meetings, or use for other general background briefing and information purposes.

Oil Spill Dispersants

One tool used occasionally in oil spill response is chemical dispersants. Under strict approvals and a narrow set of conditions, dispersants can be sprayed from planes, helicopters or boats onto oil spills in California marine waters. Chemical dispersants break a slick into smaller droplets, promoting mixture of oil into the water column, and accelerating dilution and biological degradation.

Conditions of use

- Federal and state approval for dispersant applications in California is considered when an effective conventional response is not feasible or not totally adequate in containing or controlling the spill.
- Before dispersants are used the response agencies will use all real-time information at their disposal to determine the resources at probable risk from both the oil and the dispersants used against it. Any dispersant application must follow strict guidelines laid down by several agencies and the groups, biologists and community members that assist with advice to those agencies. The federal and state response agencies will make every effort to communicate their oil spill response decisions to the public, through the media and/or in public meetings.
- The primary oil spill response method used in California is mechanical containment and recovery, which involves the use of containment booms, skimmers and other related equipment. The many hindrances to spill recovery, however, place a real advantage to having many "tools in the toolbox", as historically, no more than 10 percent of the oil has been recovered from large marine spills. Current mechanical technology is not effective in waves greater than about 6 feet, winds greater than 20 knows, or currents greater than 1 knot.
- Dispersants are best used to protect shorelines, when the damage to the shore and nearby marine life would be worse than dispersing the oil into deeper offshore water.
- Dispersants are best used on the leading edge of oil slicks, which might otherwise get out of control and head toward shore.
- Dispersants must be applied soon after the oil is spilled and before the oil weathers or the slick is broken up. This usually means dispersant application with a matter of several hours to a few days, depending on spilled oil circumstances.
- The best conditions are whet the water is deep and when there is sufficient mixing action from waves, wind or current.

How dispersants work

- Dispersants help prevent formation of water-oil emulsions, or mousse, and they speed up biological breakdown of oil by natural marine organisms. They also ability of oil to stick to sediments and other organisms in the water.

Limitations on dispersant application

- Only dispersants approved by federal and California state governments can be used, and only on oils that have a fairly high likelihood of being "dispersible".
- Ocean and weather conditions must be conducive to dispersant use.
- The spilled oil must be at least 3 miles from shore and not within a National Marine Sanctuary, or other agency approvals will be required before they can be used.
- Dispersant use must be considered to provide a "net environmental benefit" – in other words, once the oil is spilled, resources somewhere are going to be negatively impacted, so the goal is to minimize impacts to the most sensitive resources in the area at the time of the spill.
- Dispersants have to be applied safely, and dispersants cannot continue to be used if they are not effective.

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APPENDIX G

SEAFOOD TAINTING PLAN

G.1 Overview for Managing Seafood Concerns During an Oil Spill

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The following material is drawn largely from three documents:

Mearns, A.J. & R.Yender, 1997. A summary of a NOAA workshop on management of seafood issues during an oil spill response. Proc. Arctic and Marine Oil Spill Program Technical Seminar. Environment Canada, Vancouver, pp. 203-214.

Reilly, T.I. and R.K York. 2001. Guidance on Sensory Testing and Monitoring of Seafood for Presence of Petroleum Taint Following an Oil Spill. NOAA Technical Memorandum NOS OR&R 9.107pp.

Yender,R., J. Michel, and C. Lord. 2002. Managing Seafood Safety After an Oil Spill Seattle: Hazardous Materials Response Division., Office of Response and Restoration, National Oceanic and Atmospheric Administration. 72 pp.

Technical Specialists and Experts

National Oceanographic and Atmospheric Administration
Ms. Ruther Yender
Ruth.Yender@noaa.gov

Dr. Alan Mearns
(206) 526-6081
Alan.A.Mearns@noaa.gov

U.S. Food and Drug Administration

California Department of Public Health
Mr. Greg Langlois
glangloi@ix.netcom.com

Office of Environmental Health and Hazard Assessment
Mr. Robert Brodberg
(916) 324-4763
rbrodber@oehha.ca.gov

California Department of Fish and Game – Office of Spill Prevention and Response
Dr. Julie Yamamoto
(916) 327-3196
jyamamot@ospr.dfg.ca.gov

Ms. Yvonne Addassi
(916) 324-7626
yaddassi@ospr.dfg.ca.gov

Seafood safety is a concern raised at nearly every oil spill incident of any significance. Both actual and potential contamination of seafood can substantially affect commercial and recreational fishing, subsistence seafood use and generate public health concerns. Loss of confidence in seafood safety and quality can impact seafood markets long after any actual risk to seafood from a spill has subsided, resulting in serious economic consequences. Protecting consumers from unpalatable and unsafe seafood is a primary objective of federal and state public health agencies after a spill occurs.

The purpose of this guidance is to identify the various problems that can arise and to describe the remedies available. The information is aimed primarily at those in the fisheries sector suffering economic loss as well as spill responders and managers with responsibilities for protecting public health, and consumers concerned about the safety and quality of seafood. Interested parties are encouraged to share experience gained in managing fishery resources during oil spills. Guidance will be changing as a result of recent California legislation (2008 AB 2935 Huffman) mandating fishing closure in response to il spills, but implementing procedures are under development. Seafood managers may be faced with making many urgent decisions after an oil spill, often based on limited data:

Should seafood harvest in the spill area be closed or restricted?

If closed, what criteria should be applied to re-open a fishery?

How should seafood safety and palatability be evaluated?

How can health risks best be communicated to the public?

Public health officials and other seafood managers do not routinely deal with oil spills as part of their day-to-day responsibilities. Consequently, they typically have little experience with risks to seafood from oil spills when they suddenly are faced with determining appropriate seafood management actions in response to a spill.

Subsequent to an oil spill, there are three separate areas of concern that are often grouped together under the broad definition of "seafood tainting." The Unified Command will need to adequately address each issue in turn as well as the pertinent stakeholders. These three areas can be loosely outlined as follows:

- **Seafood Tainting Concerns**: Contamination of seafood can usually be detected as a petroleum taste, or taint. Public confidence in seafood products can quickly erode as a result of suspect, or actually contaminated products reach the market. The presence of taint simply indicates that flavor or odor is altered; it does not characterize the nature of the off-flavor or off-odor, quantify the degree of taint, or imply any human health hazard. Although health concerns are usually generated from seafood taint, "tainting" is primarily a marketing concern regarding the salability of seafood. It is reasonable to conclude, with respect to oil spill contamination, that if seafood is not "tainted," it is acceptable for consumption.

  Seafood tainting panels can be established on a spill-specific basis by contacting the U.S. Food and Drug Administration. Additionally, the U.S. Coast Guard can close a particular "area of operation" to fishing and/or seafood harvest as a part of the emergency powers of an oil spill.

- **Public Health Concerns:** The occurrence of contamination in seafood organisms or products following an oil spill can lead to public health directives being involved because of the presence of known carcinogenic compounds in petroleum products. The aromatic fractions of oil contain the most toxic compounds, with polycyclic aromatic hydrocarbons (PAH) being of greatest concern. The California Department of Public Health (CDPH; see **Appendix A**) should be contacted to determine chemicals of concern as well as testing levels. Additionally, the CDPH can coordinate the closure and reopening of areas and fisheries for public health reasons.

- **Trustee Agency Concerns:** Many finfish, shellfish, mollusks, and crustaceans can become contaminated during an oil spill. Petroleum contamination of finfish and shellfish depends upon a variety of biological and ecological factors, including feeding strategies, habitat utilization, and physiology. The ecological and population impacts of a spill will be species and habitat specific. The California Department of Fish and Game (CDFG) has the primary state trustee authority for these resources and can be contacted to determine if biological and ecological factors are a concern for a given resource. Additionally, the CDFG can close any fisheries under its jurisdiction for population health concerns.

Fishing is important in all maritime nations and many oil spills cause damage to subsistence, recreational and commercial fishing activity. Aquaculture enterprises have become widely established, thereby increasing the

sensitivity of many coastal areas to oil pollution impact. Increased public awareness and heightened food quality and safety standards have meant that even small oil spills can cause a large impact and generate strong political interest.

Oil pollution effects take a variety of forms. Animals and plants may be killed as a result of oil smothering and toxicity. Catches and cultivated stock may become physically contaminated or acquire a taint. Fishing and cultivation gear may be oiled, leading to the risk of catches or stock becoming contaminated or fishing being halted until gear is cleaned or replaced. The handling of seafood products in bulk means that it is seldom practical to locate and remove the oiled specimens.

Fishermen and aquaculture operators are often on the front line of oil spill impact, but equipment suppliers, transporters, wholesalers and others are also involved in the process of bringing seafood produce to the market. Government authorities have a duty to protect public health and ensure that seafood products reaching the consumer are safe and palatable. A number of management strategies are available to prevent or minimize oil pollution impact on fishing and aquaculture activity. Fishing and harvesting restrictions can be imposed to prevent contamination of fishing gear and to protect consumers and markets. Such measures also provide time for evaluating risks and for organisms and their habitat to recover from oil contamination.

Oil spill impact on seafood resources

The impact of an oil spill on marine life depends largely on the physical and chemical characteristics of the oil and the way these change with time, a process known collectively as "weathering". The main physical processes which act on the oil during the course of a spill are evaporation, natural dispersion and, to a lesser extent, sedimentation. Specific gravity, viscosity, chemical composition and toxicity of the pollutant and the way they change with time tend to determine the degree of oil exposure for seafood organisms. The prevailing weather and sea conditions will determine the movement of spilled oil. Clean-up activities such as the use of chemicals or aggressive washing techniques can also affect the fate of oil. Thus, a variety of factors combine to define the character of a particular oil spill and the fate of sensitive resources in its path.

Adult free-swimming fish, squid, shrimp and wild stocks of other commercially important marine animals and plants seldom suffer direct harm from oil spill exposure. This is because only rarely will oil concentrations in the water reach sufficient levels to cause tainting or mortality. The greatest impact is found on shorelines and shallow waters where animals and plants may be physically coated and smothered by oil or exposed directly to toxic components in the oil. Edible seaweeds and sea urchins are examples of shoreline species that are especially sensitive to smothering and oil toxicity, respectively. Apart from direct effects, oil may cause more subtle long-term damage to behavior, feeding growth, or reproductive functions. It is a complex task to isolate these sublethal pollution effects from the influence of numerous other factors.

As a general guide, dispersants should not be used close to aquaculture facilities or spawning grounds and nursery areas. Stripping oiled seaweed from rocks and indiscriminate hot water washing are examples of aggressive response techniques that can affect commercially exploited species and delay natural recovery.

Fishing and aquaculture activities

Oil can foul the boats and gear used for catching and cultivating commercial species. Flotation equipment, lift nets, cast nets, and fixed traps extending above the sea surface are more likely to become contaminated by floating oil, whereas lines, dredges, bottom trawls and the submerged parts of cultivation facilities are usually well protected, provided they are not lifted through an oily sea surface or affected by sunken oil.

Seaweeds, shellfish and cultivated animals kept in cages or tanks are usually unable to avoid contact with oil contaminants in the water and the presence of oil pollutants may significantly add to the stresses already imposed by keeping animals in artificial conditions. Floating oil may physically coat fish-farming facilities, and unless they are rapidly cleaned they may act as a longer-term source of stock re-contamination.

There are many complex influences on the health of cultivated organisms and observed effects may be the result of a combination of factors. If, for example, the stocking density or the water temperature in a fish farm is unusually high, there is a greater risk of mortality, disease or growth retardation occurring as a result of oil contamination.

The cultivation of seaweed, fish, crustaceans, mollusks, echinoderms and sea squirts frequently involves the use of onshore tanks to rear the young to marketable size, or to a size and age suitable for transfer to the sea. Such facilities are usually supplied with clean seawater drawn through intakes located below the low water mark. The intakes may occasionally be under threat from sunken oil or dispersed oil droplets, which may lead to contamination of pipework and tanks and the loss of cultivated stock.

Fishing and seafood cultivation are not always pursued throughout the year and seasonal differences in sensitivity to oil spills can therefore occur. The collection of wild seed, or the rearing of larvae in onshore tanks supplied with water piped from the sea is one example of seasonal activity.

Tainting

The contamination of seafood can usually be detected as a petroleum taste, or taint. Public confidence in seafood products can quickly erode as a result of suspect, or actually contaminated, products reaching the market. Filter-feeding animals such as bivalve mollusks are particularly vulnerable to tainting since they may easily ingest dispersed oil droplets and oiled particles suspended in the water column. Animals with a high fat content have a greater tendency to accumulate and retain petroleum hydrocarbons in their tissues.

A taint is commonly defined as an odor or flavor that is foreign to a food product. Background concentrations of oil in water, sediment and tissues are highly variable and both the degree of taint that may result and consumer tolerance levels for taint are different for different seafood products, communities and markets. The presence and persistence of taint will depend mainly on the type and fate of oil, the species affected, the extent of exposure, hydrographic conditions and temperature. Tainting of living tissue is reversible but, whereas the uptake of oil taint is frequently rapid, the depuration process whereby contaminants are metabolized and eliminated from the organism is slower.

The concentrations of hydrocarbons at which tainting occurs are very low. Some of the chemical components in crude oils and oil derivatives with the potential to cause tainting have been identified but many are unknown and no reliable threshold concentrations for petroleum-derived tainting agents have been established. Hence it is not possible to determine by chemical analysis alone whether a product is tainted or not. However, the presence or absence of taint can be determined quickly and reliably by sensory testing, when a trained panel and sound testing protocols are employed. Sensory testing is further described below.

Public health concerns

The occurrence of contamination in seafood organisms or products following a major spill has potentially damaging implications for marketing and can lead to public health directives being invoked because of the presence of known carcinogenic compounds in petroleum products. The aromatic fractions of oil contain the most toxic compounds, and among these it is the 3- to 7-ring polycyclic aromatic hydrocarbons (PAH) that command greatest attention.

The input of potentially carcinogenic PAH stems largely from combustion sources and petroleum and, for the human population, exposure to PAH is primarily from food. However, in common with other potentially carcinogenic pollutants, it is not possible to define a concentration threshold of potential carcinogens in seafood products that represents a risk-free intake for humans. Furthermore, a wide variety of smoked food, leafy vegetables and other dietary components also contain the same PAH compounds. The detailed composition of

the diet determines which food items are major contributors for individual consumers. It is important to recognize that different regions and ethnic groups have varying levels of seafood in their diets.

Generally, PAH levels in foods are not subject to legislative limits, although limits exist for some compounds in drinking water. The risk to an individual or community from oil spill-derived carcinogens should be assessed in the context of the overall exposure from all potential sources, which is subject to many variables. From a general risk evaluation of the amount, frequency and duration of PAH exposure following oil spills, most studies have led to the conclusion that oil spill-derived PAH contamination of seafood is not a significant threat to public health. However, it is important to note that while toxicologists have assessed the threat to public health as negligible, it may be difficult to convince local users, fish buyers and consumers in general, especially when there is an option of buying seafood from other locations.

A further complication for food safety and quality controllers is that a seafood diet is inherently nutritious and rich in protein and vitamins. Restrictions on seafood intake can cause consumption patterns to shift toward less healthy diets. Other forms of contamination, such as heavy metals, algal toxins, pathogenic bacteria and viruses, also affect seafood safety and quality. The potential impact of an oil spill on public health must be viewed in a wider context in order to identify and implement appropriate strategies.

Oil spill protection and clean-up response options

Booms and other physical barriers can sometimes be used to protect fixed fishing gear and aquaculture facilities, although in most cases it is impossible to prevent damage altogether. Fishing and cultivating equipment is often purposely sited to benefit from migration routes or efficient water exchange. Such locations are characterized by fast water flow, which is where booms will not perform well.

Sorbent materials are often useful for removing oil sheens from water and tank surfaces. Sorbent booms are easy to deploy and move, and serve to control sheens in floating cultivation pens. However, oil-saturated sorbents should be replaced regularly to avoid them becoming a source of secondary pollution. Another potential concern when dealing with aquaculture facilities is the risk of spreading disease with booms and other equipment moved from one location to another.

Dispersant should be used with care so as not to cause tainting of shellfish and captured or cultivated stock. As a general guide, it is not prudent to use dispersant in shallow waters where fishing or aquaculture is important. However, if used at a safe distance, dispersants can reduce or prevent contamination of equipment by floating oil. It is difficult to define in general terms what represents a safe distance since this will depend on dilution rates and the strength and direction of prevailing currents.

The remedial methods employed should be chosen with care, so as not to make matters worse. Almost all clean-up techniques cause damage, which should be taken into account when considering the merits of removing oil pollution from an affected area. For example, attempts at cleaning intertidal mudflats can cause long-term disruption and damage to the habitat of cockles and clams. There are occasions when it is better to rely on natural recovery processes for oiled habitats than to inflict more damage from clean-up measures known to be futile.

Sensory testing

Oil-tainted food is unpalatable even at very low levels of contamination, which provides a safety margin in terms of public health. As a generalization, if seafood is taint-free, it is safe to eat. Properly conducted sensory testing is the most efficient and appropriate method for establishing the presence and disappearance of tainting, and for indicating whether seafood is fit for human consumption. The International Standards Organization (ISO) provides information on the training of sensory evaluation panels. A trained sensory panel using properly prepared samples and a written testing protocols are essential elements in sensory testing in order to obtain

reproducible results. In some cases of potentially unsafe seafood it may be appropriate to avoid taste tests and instead focus on olfactory testing.

A sampling program with defined objectives will often be necessary to determine the degree, spatial extent and duration of the oil contamination problem. The aim is to take and analyze the number of samples necessary to obtain statistically reliable results. Target species are those of commercial, recreational or subsistence fishing value and which are commonly consumed. Samples of animal and plant tissue are perishable and must be secured and stored so as to preserve their integrity. Control samples from a nearby area unaffected by oil pollution are important for reference purposes and to eliminate the interference of background contamination, but are difficult to find in practice. In the case of commercial species it is sometimes possible to obtain reference samples from the marketplace. If appropriate reference samples cannot be obtained, a trained panel of expert testers should nevertheless be able to determine when seafood is taint-free.

In principle, a relatively small number of samples are sufficient to confirm the initial presence of taint and define the affected area in order to introduce a restriction. Monitoring the progressive loss of taint, by sampling at appropriate intervals thereafter, allows the point at which taint disappears to be determined with some confidence. The oil type would determine the frequency of sampling, the habitat and organisms affected, and the rate at which depuration was observed to occur. A time series of samples gives clues to depuration rates and allows future trends to be predicted. While it is not an absolute requirement to have reference samples in order to conduct a sensory evaluation, the taint-free threshold can best be defined as the point where a representative number of samples from the polluted area are no more tainted than an equal number of samples from a nearby area or commercial outlet outside the spill zone. Account should also be taken of levels considered acceptable in comparable seafood species being harvested in other areas of the country.

This approach is inherently fair and recognizes that tainted samples, not necessarily due to oil spills, can occur in any population. Once two successive sample sets over a short period of time remain clear, restrictions can be removed or the scope of the ban adjusted as a distinct area or species is shown to be free of taint. The confidence in accepting that the fish or shellfish are clean and safe following a particular spill comes from an adequate time-series of monitoring data showing the progressive reduction in taint.

Chemical analysis

In some cases, the chemical composition and the fate of the spilled oil, widespread subsistence fishing and aquaculture, or the presence of commercial shellfish resources in the path of the oil may argue for chemical analysis to be undertaken. Chemical screening for exposure can complement sensory evaluations and help validate sensory testing. Sensory evaluation does not preclude the need for chemical analysis and may serve as a screening tool for selecting samples for further chemical analysis.

It is widely recognized that to impose a single fixed standard for PAH levels in seafood by reference to baseline data is unworkable for several reasons. Baseline data are rarely available and unlikely ever to be applicable to the conditions prevailing during a particular oil spill. Background levels of hydrocarbons, where they are known, vary greatly and are subject to both pyrogenic and chronic anthropogenic input. PAH intakes in seafood meals also vary greatly between different communities, as do the perceived sensitivities of individual consumers. One viable approach is to ensure that samples should be taint-free. PAH levels in the samples may also be compared to reference samples collected just outside the affected zone or which are freely marketed elsewhere in the country. However, this may be difficult to implement in areas that are known for their "pristine" seafood.

Analysis of water and sediment is usually not necessary since the condition of seafood organisms inhabiting water and sediment environments is of primary interest. In any case, the organisms effectively “monitor” the condition of their surrounding environment by the process of accumulating and depurating